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Popular Science

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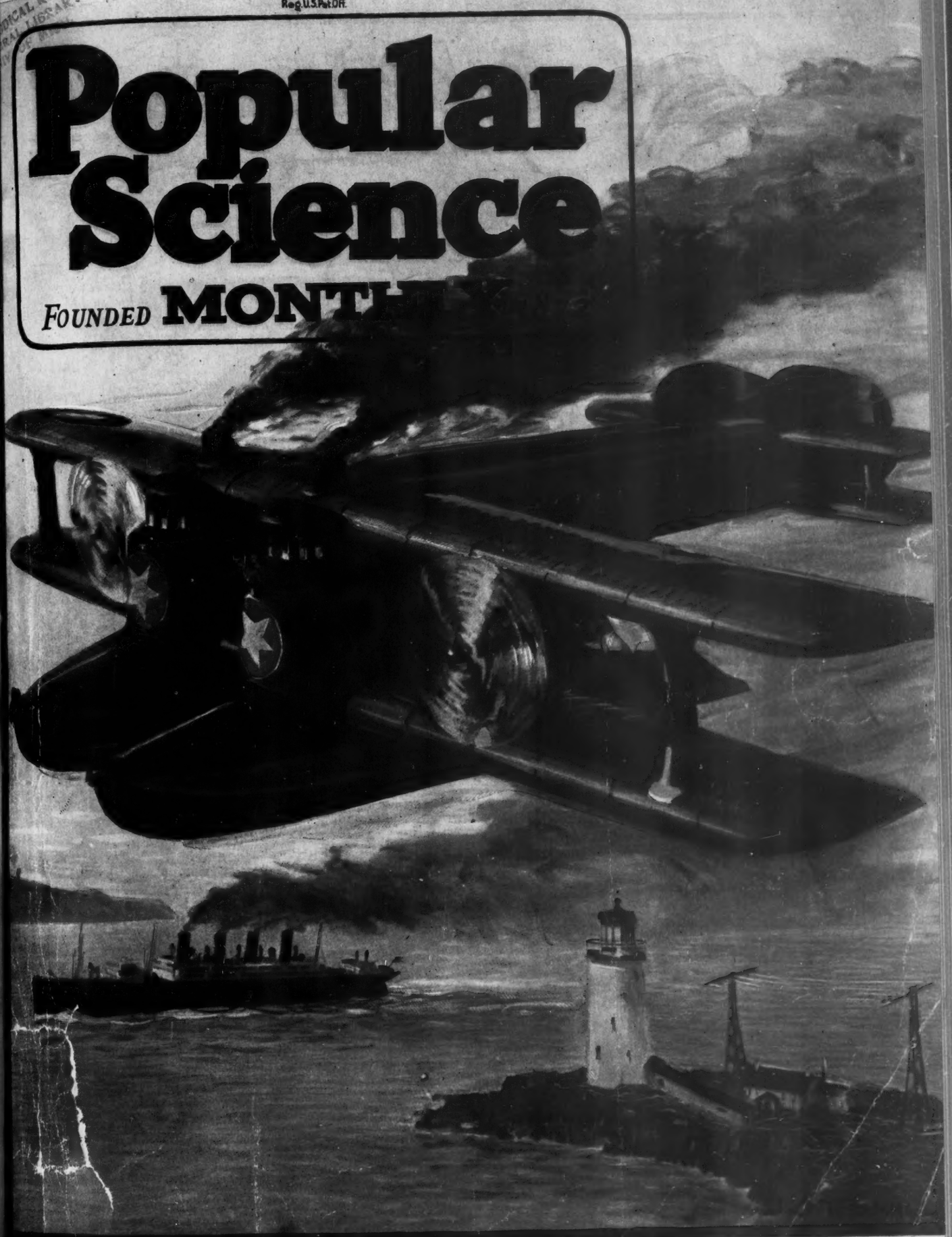

How Airplane Engineers are Experimenting with Steam (See page 28)

AUGUST **Bryan on Evolution** 25 CENTS

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POPULAR SCIENCE MONTHLY

Most Wonderfully Illustrated Magazine in the World

AUGUST, 1923; Vol. 103, No. 2
25 cents a Copy; $2.50 a Year

Published in New York City at
225 West Thirty-ninth Street

"WHAT qualities in men are of greatest value to science?" A reader asks that question. Progress in science, like progress in everything else, must have imagination and enthusiasm for its foundation. Imagination pushes the human mind forward. It is the basis of the useful, material accomplishments of men. Enthusiasm is the driving force. It stirs the will which releases the energy *to do*. It gives science the courage to overcome obstacles, the bravery to dare new things. Each new invention, each forward step in the business of living, has imagination and enthusiasm behind it.

* * *

TURN to page 21 and read the dramatic story of how, at the will of a single man, has been created power enough to light every home in the United States. Never before has such tremendous energy been concentrated by human ingenuity. Remember that a century ago a French scientist Hauy said that electricity had no more important steps before it. But Hauy did not reckon on the imagination and enthusiasm of Michael Faraday, who even then was in a London basement working out the relationship between electricity and magnetism that led to the dynamo, to radio and to the tests just made. As a result of these tests babies born today may live to see some of the achievements of ages of natural evolution duplicated in an electrical laboratory in a single day.

* * *

GEORGES BARBOT, Frenchman, has been showing Americans how to fly at a minimum cost for airplane and power. But nature can outdo M. Barbot. On page 49 is a remarkable pictorial article on how nature's gliders are designed. Successful as Barbot's tiny motor apparently has been, it is crude and undependable as compared to these living engines, which may point the way to perfection in aeronautics. Food for thought in contact with nature, anyway. Some day some imaginative man studying the firefly even may learn how to manufacture light without heat.

DR. GUY OTIS BREWSTER, noted physician, asks: "Do you know how to take a bath?" It has a silly ring to it, that question. But is it so silly? Read his helpful article on page 45 before you answer. Doctor Brewster believes that most of us do not know how, when, where and why we should bathe. If true, it is easily explained. Science has sought only a physiological understanding of bathing in recent years. In fact, it is only 81 years since the first immovable bathtub was established in an American home. The Virginia legislature and the cities of Charleston, Hartford, Providence and Wilmington made determined efforts to discourage the spread of "the menace." But Adam Thompson of Cincinnati had the imagination to build the tub. And he had the enthusiasm to overcome the obstacles placed before him.

* * *

IN this month's chapter of "The Story of Man and His World," Dr. E. E. Free unravels the fascinating history of speech and writing. There is human imagination behind every step of the progress across the thousands of years. An imaginative man, reading the story, may say to himself—"how short our lives are after all!" Each of us may live 60 or 70 years, just a flash in eternity. Some future scientist may dig up our skulls and seek to read from them the answer to our cumbersome methods of transferring thought. He may call us a primitive people—folk who did not even know how to transmit thought telepathically—without sound and without instruments.

* * *

BUT man progresses. A few short months ago people called transmission of thought through ether a miracle. Today radio is a recognized part of our daily lives. Experts, such as Jack Binns, our radio editor, whose informative article appears on page 57, are developing new processes and instruments rapidly. Radio proves that given human imagination harnessed to human enthusiasm, there can be human accomplishment.

See Table of Contents on page 112

POPULAR SCIENCE MONTHLY

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H. J. Fisher, *President*; R. C. Wilson, *Vice-President*
O. B. Capen, *Secretary and Treasurer*

THEY SAY—Brief Bits of Timely Comment On the Sciences of the Hour

BRIG. GEN. WILLIAM MITCHELL, assistant chief of the United States Army Air Service, one of the leading factors in the progress of American Army aviation, who is shown below with the new Curtis metal scout plane in which he made test flights recently:

"Aviation is producing a profound effect upon geology. This is being done through aerial photographs. There is no mountain top in the world that cannot be photographed from an airplane, nor is any canyon too steep to yield its secrets."

Brigadier General William Mitchell

MAJ. GEN. JAMES G. HARBOARD, head of the Radio Corporation of America whose work on communication in the army was one of the outstanding features of the war:

"Wireless as a tool of civilization will be incomparably important. The closer we can bring the people of the world to one another the better will that world be as a place to live in. Conflicts almost always are results of mutual misunderstanding. I believe it is as fallacious and dangerous to rely wholly upon courage, devotion and resources of the people, without practical preparation, as it is futile to depend upon isolated position or arbitration to protect us from war."

PROF. FREDERIC LEONARD WASHBURN, of the University of Minnesota, State Entomologist of Minnesota, who dons the "Lava lava" costume to keep cool while chasing elusive insects in Hiva-oa, one of the Marquesa Islands in the South Pacific:

"Not many years ago an entomologist was looked upon as a harmless non-utilitarian, and the word called to mind the picture of the spectacled and bearded lunatic, wildly waving an insect net and pursuing a flitting butterfly over field and bog.

"Of late years the science of entomology is being recognized as of great practical importance in fighting destructive insects."

THEODORE E. BURTON, congressman from Ohio, ex-United States Senator, author and one of America's foremost politicians:

"Science leads and politics follows. Science has a permanent effect on our everyday life, while politics deals mostly with the transitory problems of the day."

FRANK B. JEWETT, President, American Institute of Electrical Engineers:

"In surveying the future there are certain potential sources of energy which it may be found possible to develop. For example, some efficient and direct utilization of solar energy may be developed; or the energy of tidal motions may be made more largely available. Possibly a more promising lead is an indirect utilization of solar energy from vegetable growths."

Theodore E. Burton *Elmer E. Sperry*

ELMER E. SPERRY, president of the Sperry Gyroscope Co. and distinguished American inventor, shown holding a model gyroscope:

"The need of the hour is the conservation of our irreplaceable liquid fuel resources. Almost their entire use for various purposes is now conducted by methods no less than criminally wasteful, such as burning them in mass under our boilers.

"Engines can be made, in fact are now operating, by means of tar, crude petroleum or many of their by-products. With such an engine available at this moment, or gradually substituted for the gas engine, we would have in hand a complete solution of the petroleum problem, not only rendering five and six times as much fuel available, but one which would not require highly organized fuel like gasoline."

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POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
AUGUST, 1923

Man Steals Jove's Thunder

Crackling of 2,000,000-Volt Lightning Bolts in Laboratory Reveals New Wonders of Science

By
Raymond J. Brown

Frank William Peek, Jr., the modern Jove who hurls 2,000,000-volt lightning bolts in the laboratories of the General Electric Company at Pittsfield, Mass.

IN A steel-lined, brick building in Pittsfield, Mass., a few weeks ago, occurred an event which electrical engineers say ushers in a fascinating new scientific era and which may even alter the course of the future history of the world.

A 2,000,000-volt lightning bolt, greater in strength than the combined output of every electrical generator in the United States hissed and thundered in terrifying purplish flames through the research laboratory of the General Electric Company, then shrank and died to silence as a grimy, spectacled electrician turned a switch.

This remarkable photograph shows man-made thunderbolts striking a church steeple and a dwelling in the miniature village set up in the General Electric Company laboratories. Lightning rods protected the buildings from damage

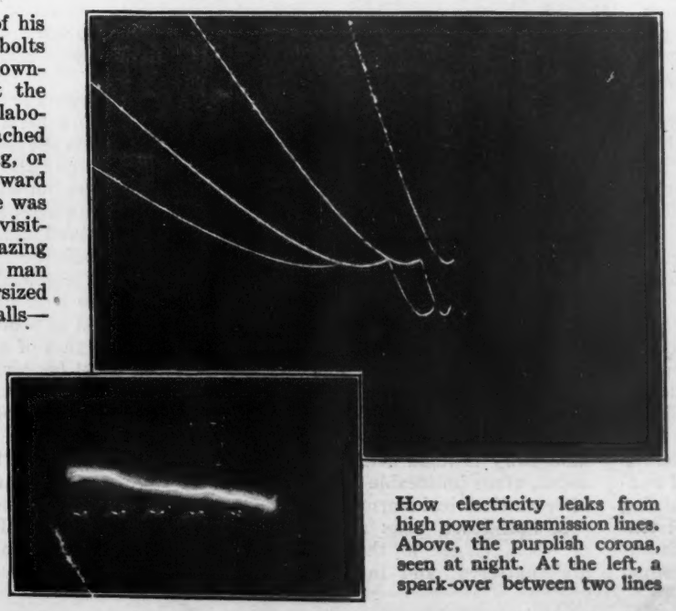
It was the greatest man-made discharge of electrical energy ever seen on earth—10,000,000 horsepower—rivalling in destructive potentiality the very thunderbolts of heaven. And at all times man, who had made it, held it obedient and pliable to his will. When he closed his switch, the huge, sputtering flames leaped eagerly from their prison. When he opened it, their awe-inspiring roar faded to a faint crackle—and died away.

Man directed the course of his manufactured lightning bolts where he willed—upward, downward. Now they licked at the steel girders supporting the laboratory roof; again they reached down hungrily to the flooring, or stretched their angry arms toward the high metal gallery where was huddled the little cluster of visitors invited to view the amazing demonstration. But always man—represented by an undersized laboratory helper in overalls—held them in control.

Before that day man never had succeeded in developing an electrical pressure greater than 1,000,000 volts. The feat of producing, controlling and releasing electrical energy in double that amount is, of course in itself a scientific achievement bound to stir the imagination of the world. Yet it is as nothing when compared with the practical, scientific possibilities opened by the success of the Pittsfield experiment.

Is man, after centuries of striving, at last to make himself independent of nature and to harness her mightiest forces to his needs?

Even now almost a quarter million volts are being carried commercially into the city of Los Angeles from a water power development 240 miles away. What are we to say of a force combining intense heat and terrific pressure that might produce coal as Nature does, but more scientifically and in infinitely less time? A force capable of levelling mountains, draining rivers, destroying cities and armies in time of war; but withal the greatest boon ever offered mankind, because it could control climate, open the floodgates of the skies by electrically condensing the vapors in the clouds and substitute for the sun in furnishing the warmth that makes the earth bear its fruits for mankind?



How electricity leaks from high power transmission lines. Above, the purplish corona, seen at night. At the left, a spark-over between two lines

Frank William Peek, Jr., the research engineer who devised and set up the apparatus by which lightning is produced and controlled, admitted after the experiment that his achievement offers the most amazing possibilities.

"The experiments we have been conducting with an electrical discharge of 2,000,000 volts," he said, "undoubtedly have resulted in the creation of substances or gases not previously existing in materials subjected to lightning strokes. Just what these are, though, we do not know.

"In splitting heavy blocks of wood with lightning, we have discovered clean-cut holes mysteriously bored through the blocks. We know that the wood has not been burned away. What has become of it? We are trying to find out.

"We have found that we can puncture a jar of water with a lightning stroke and that part of

the water instantly disappears. Where does it go? We know it hasn't evaporated. In both instances the substances have suffered changes which are not explained by any known laws of chemistry or physics."

"Does that mean that the new development of high voltages may lead to discoveries that will force us to discard all known laws of chemistry and physics?" he was asked.

May Speed Nature's Processes

"Who can say?" he asked in reply. "The alchemists of old sought to bring about the transmutation of matter—the change of one substance into another entirely different. Modern chemists have laughed at them. But we have observed many strange and unexplainable things in our experiments with lightning! Our whole world consists of materials changed from other materials by the chemistry of nature. Perhaps it will be possible to aid nature in making those changes, to hasten them, to create quickly what nature takes centuries to make.

"There is coal, for example. Nature makes coal by causing chemical changes in vegetable matter which has been driven into the earth. Will it be possible for us to speed that process?

"Consider, too, our climate, our weather, the growing of our crops for food. Who will say that in the future it will not be possible to produce rain at will by hurling huge charges of electricity into the air? Or that a warmth like the warmth of the sun, which causes the seeds in our farmlands to germinate, cannot be supplied to the soil by electricity?

"Such achievements are not yet near us. But I should hesitate to say that they are impossible.

"Undoubtedly the first practical use to which our discoveries in lightning manufacture will be put is the transmission of electricity at great voltages for light and power. This was the primary aim of our experiments.

"When we produce power in our electrical generators it is necessary to 'step-up' the voltage in a transformer to give it force enough to carry it through a distance. When it reaches its destination over the transmission line, this process must be reversed in order to deliver the power in safe values for motors and light. The greater the distance, of course, the higher the voltage necessary.

How Electricity Leaks

"When the voltage becomes very high, the electricity leaks from the lines in 'corona'—electrons or infinitely small particles of matter which cause high tension lines to glow at night with purple radiance—or by 'spark-over' between the wires carrying the power. This leakage increases during rainy weather.

"To solve the problems of decreasing leakage we devised apparatus capable of producing 2,000,000 volts and with it endeavored to reproduce all conditions of operation over model transmission lines."

Lightning is produced in the Pittsfield laboratories by releasing a huge voltage that has been impounded in a giant condenser. This condenser, towering 30 feet above the flooring, consists of 480 glass plates, coated on both sides with glittering tin foil and mounted in 48 frames or cells. The condenser units are 15 feet high and are supported by post insulators of glass, about 15 feet tall and three feet in diameter at the base.

The visitor to this house of wonders is conducted to a steel gallery where is situated the switch controlling the lightning machine. There is an odd feeling of tension in the air as the laboratory assistant throws the switch. For an infinitesimal part of a second there is silence. Then from the discharge points shoots a huge, purplish flame, extending 18 feet from the machine, zig-zagging about as lightning does in the sky, crackling and roaring like a volley from thousands of muskets.

The visitor is deafened. Shivers creep along his spine. A subtle, pulling sensation seems to draw him from the gallery toward that thundering purple arc. He observes that the hair of the man beside him is standing out stiff and straight, like the quills of a porcupine.

The flash takes on a filmy, lacy texture as it widens out. The atmosphere of the laboratory is filled with the fresh odor of ozone, often noticeable in the atmosphere after an electrical storm.

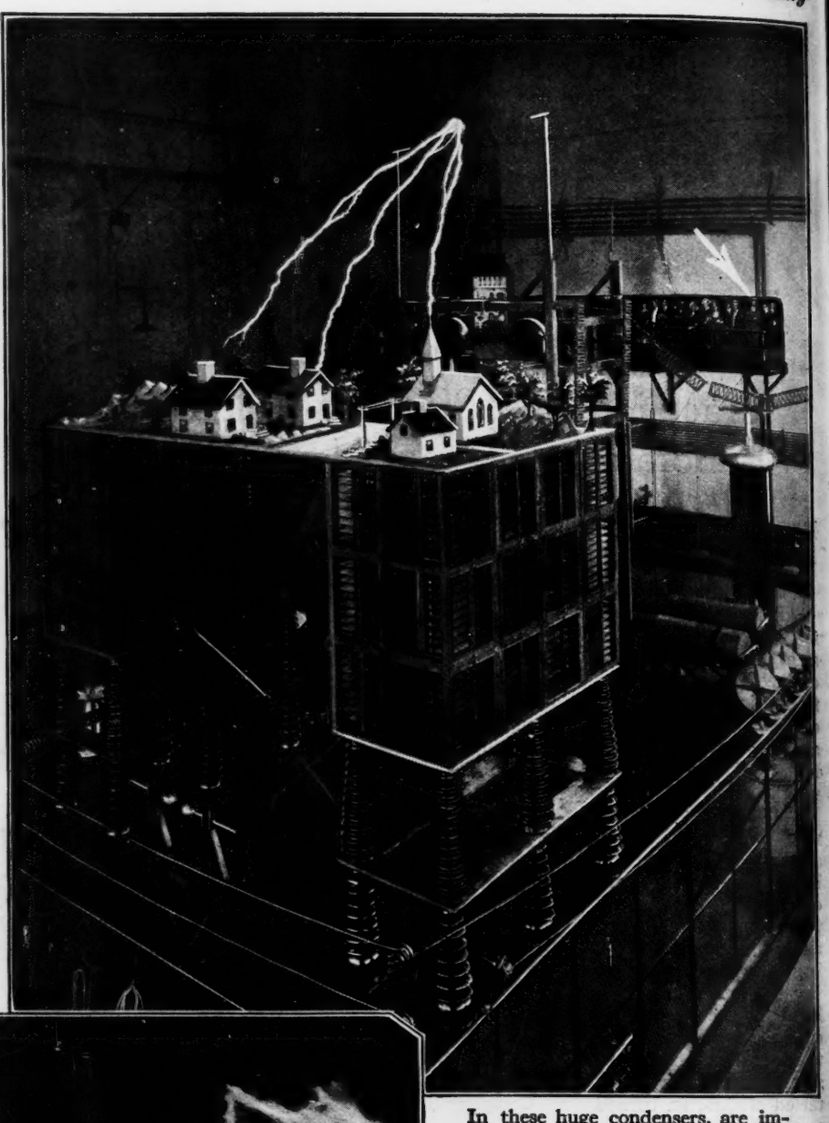
A half-dozen tests are made. Blocks of wood, placed in the path of the arc, are shattered, and in each of them is noted the unexplainable void in its structure. Other experiments are carried on to show the effect of the tremendous electric bolts on oil, water, glass, and porcelain. These tests are valuable in solving the problem of insulation which is the principal barrier to the transmission of infinite quantities of electricity over commercial lines.

Then comes a final test—the most dramatic of all. A miniature village—church, general store, dwelling house—is set between the discharge posts. The switch is closed and the destructive flashes of lightning are hurled at the tiny structures. The church steeple is struck, then the store. Yet they stand undamaged! On their even walls and roofs there is no sign even of scorching.

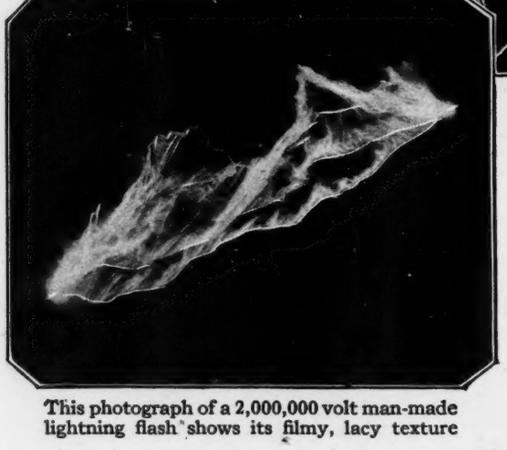
The explanation? Lightning rods. If anyone ever doubted the efficacy of that method of protecting buildings against the onslaughts of atmospheric electricity, here is proof for him.

The demonstration ends. The spectators climb down from the gallery thrilled by an odd exaltation. They have seen a miracle. They have witnessed man usurping the powers of Olympian Jove.

Certainly the most amazing spectacle offered since Benjamin Franklin with his kite brought to man his first knowledge of the mighty force—electricity!



In these huge condensers, are impounded the 2,000,000 volts to produce terrific lightning flashes shown striking a miniature village. Arrow points to spectators' gallery



This photograph of a 2,000,000 volt man-made lightning flash shows its filmy, lacy texture

My Views about Evolution

By William Jennings Bryan

RELIGION has no quarrel with science and cannot have because real science is "classified knowledge."

Nothing, therefore, can be scientific that is not true. All truth is of God, whether found in the book of nature or in the Book of Books; but guesses are not science; hypotheses, such as the hypothesis of evolution, are not truths.

There is a wide difference of opinion as to what evolution really means. Most of those who declare that they favor it think it means growth, like the growth of the chicken from the egg; or development from without, like the improvement of the automobile. They are mistaken. "Evolution" is the word used by scientists to describe the hypothesis which links all life together and assumes that all species are developed from one or a few germs of life by the operation of resident forces working from within.

My purpose here is to show that science, as well as the Bible, condemns evolution. If science is classified knowledge, then we are justified in rejecting as unscientific anything which is not established as true. On this ground evolution should be rejected

Idea Older than Darwin

The hypothesis has its place, whether it requires four syllables to express it or is expressed in one syllable—by the word "guess." But the hypothesis is nothing more than an hypothesis until it is proven true.

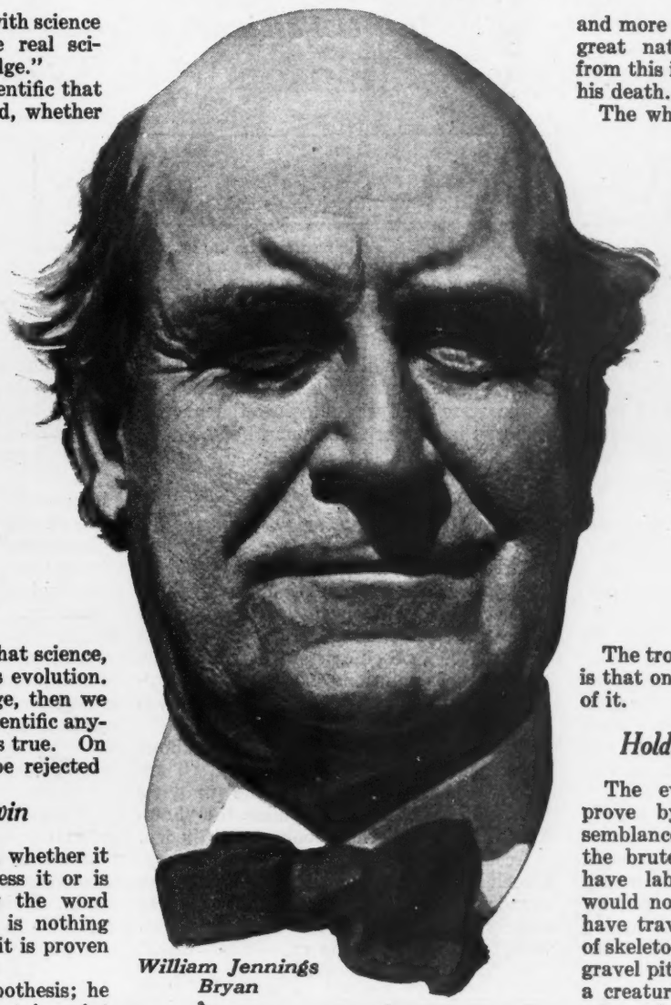
The prospector uses the hypothesis; he guesses that there is ore at a certain point on a mountainside, and digs a pit to prove it; but the pit is not a mine until he finds the precious metals.

So with the lawyer; he tries his case upon the hypothesis; but the decisions of the court show that at least half of these hypotheses are wrong.

So with the scientist. It is part of his business—guessing is his middle name. He formulates an hypothesis and then tries to prove it; but most of the hypotheses advanced by scientists in the name of science have been proven erroneous.

Take evolution, for instance. It did not originate with Darwin nor with his grandfather. People have been guessing as to the origin of man as far back as there have been means of recording guesses. There is enough physical similarity between man and the brutes about him—although they are separated by infinite distance—to suggest to some ancients the possibility of a common ancestry. Darwin's connection with this hypothesis is due not to origination of the idea, but to reasons which he advanced in support of the hypothesis.

Darwin imagined that species came by slow and gradual change, one from another, and suggested two so-called laws or explanations which he deemed sufficient to account for



William Jennings Bryan

the origin of and change in species. These two laws or explanations were defined as "sexual selection" and "natural selection." Whatever he could not explain by one he tried to explain by the other. Sexual selection has been laughed out of the classroom, and natural selection is being discredited as its insufficiency is being more and more disclosed. John Burroughs, the great naturalist, announced his dissent from this in an article published just before his death.

The whole case in favor of evolution is based on physical resemblances. Those who believe in the evolutionary hypothesis reject the Mosaic account of man's creation by separate act of the Almighty and give him a jungle ancestry, but they offer only circumstantial evidence in support of their speculation.

Most scientists now reject Darwin's monkey-gorilla-ape line of descent and argue that man came by some other imaginary limb of the imaginary tree to which evolutionists attempt to trace all living things. The new limb to which they are trying to attach man's ancestry has disappeared entirely; not a fragment remains, so far as they have been able to discover, between man and the imaginary tree.

The trouble with circumstantial evidence is that one *fact* will overthrow any amount of it.

Holds Evidence Circumstantial

The evolutionists have attempted to prove by circumstantial evidence (resemblances) that man is descended from the brute. No one will deny that they have labored industriously. Men who would not cross the street to save a soul have traveled around the world in search of skeletons. If they find a stray tooth in a gravel pit they hold a conclave and fashion a creature such as they suppose the possessor of the tooth to have been, and then they shout derisively at Moses. If they find a skull, or even a piece of a skull, they summon the geologists, the biologists, the anthropologists, the fossilologists, the paleontologists, the archeologists, the psychologists, and all the other experts whom they regard as authorities and hold a post-mortem examination. Sitting as a coroner's jury, they solemnly declare that the Bible account of man's creation is a lie.

All of these resemblances and all this circumstantial evidence are overthrown by one single, indisputable fact—namely, that *no species has ever been traced to another species*, With more than a million species (Darwin estimated the number at between two and three million) to furnish proof, if there were any proof, they have so far failed to find one instance in which they can establish a descent from one species to another or change from one species to another. If the hypothesis were true, evidence of its truth could be found on every square foot of the earth's surface. Being untrue, evidence can not be found anywhere. Evolution still rests upon imagination—upon a presumption—an unproven hypothesis—a mere guess.

But the case against evolution is even stronger. Chemistry, the

(*Turn to page 95*)

ALMOST simultaneously with the publication in POPULAR SCIENCE MONTHLY of Dr. E. E. Free's fascinating serial of evolution, "The Story of Man and His World," has come William Jennings Bryan's most vigorous attack on the whole evolutionary theory.

Is science an enemy of religion? Does a belief in evolution contradict or nullify Christianity?

Questions such as these are constantly recurring in science today. Heated discussions among clergy and laymen throughout America culminated recently in a joint statement issued by 40 representative scientists, religious leaders and men of affairs, including Dr. Henry Van Dyke, famous clergyman, diplomat and poet; Dr. William J. Mayo, of Rochester, Minn.; Henry Fairfield Osborne, president of the American Museum of Natural History, New York; and Herbert Hoover, secretary of commerce. They united in declaring that science and religion "meet distinctive human needs rather than displace or oppose each other."

Invited by POPULAR SCIENCE MONTHLY to present his views, Mr. Bryan has summed up his chief arguments against evolution here. Every reader, whether he agrees with Mr. Bryan or not, should be interested in what he has to say.

How Speech and Writing Began

From Cave Pictures of the Past to the Modern Printing Press

Sixth Article in the Fascinating Series,

"The Story of Man and His World"

By E. E. Free, Ph. D.

How "Cleopatra" was written in ancient Egyptian hieroglyphics

THE oldest language that we know anything about goes back not more than eight or ten thousand years. Man, as we have seen, is perhaps a hundred times older than this. Men of quite modern type, much like ourselves in body and mind, were in the world as long ago as twenty or thirty thousand years.

Did these men speak?

We do not know. The speech of fossil men is one of the things that we cannot read from their bones or from the stone tools and other implements that they have left for us.

There is a gap here in the story of evolution. How speech began is still a mystery. It is one of the few links that are still "missing" between our animal ancestors and ourselves.

Between the bodies of men and the bodies of monkeys we know many links. There are half-way steps, transitional forms, that show us quite clearly the path of man's bodily ascent. With speech there are no such forms. Between speech and no-speech there are no connecting links at all, only an empty gap.

No animal can speak. Parrots merely repeat sounds that they have heard almost as mechanically as does the phonograph. Many animals can express emotions or very rough ideas, such as fear or hunger, by simple gestures like bared teeth or wagging tail, or by barks or whines or other cries. But none of these things are speech though they may be partial substitutes for it.

No kind of man, on the other hand, is without speech. Even the rudest and most primitive tribes turn out, when we come to know them well enough, to have languages almost as complicated and expressive as our own.

No Half-Speech Found

Scientists have not discovered anywhere in the world any instance of half-speech, any kind of language transitional between true speech and the cries of beasts, as the higher apes, for example, are transitional in bodily form between the more primitive monkeys and man.

But if we cannot discern, in the present state of scientific knowledge of these matters, how it was that human speech actually did begin, we can imagine how it *may* have begun.

The history of life, from the first specks of living slime in the primeval ocean down to the present time, is a history of accumulated inventions. In the previous chapters of this serial we have seen how our animal ancestors invented motion and warm blood and massive brains; how these inventions and thousands of others were built gradually into the marvelous mechanism of the human body. We have seen, too, how man invented cooperation and made civilization possible.

Gift of Speech an Invention

It is probable, I think, that the great gift of speech is also an invention like all these others; that it has been developed in the same way out of small and very ancient beginnings. Speech does not stand outside the story of evolution. It also, like everything else in the world, is a result of evolution.

There are two prominent theories about the probable beginnings of speech. They have been nicknamed, in the undying phrase of Professor Max Müller, the "bow-wow" theory and the "pooh-pooh" theory.

According to the "bow-wow" theory, speech began by man's effort to imitate the sounds made by animals or by natural objects. The name of the dog was "bow-wow," the name of the crow was "caw," the name of the wind in the trees was "swish," and so on.

There is no doubt that many words in all languages actually did arise in this way. Our word "hum," for instance, is a very good sound-imitation of the thing it stands for. "Slap" is another. A third is the word "patter," clearly imitative, among other similar sounds, of the pit-pat sound of raindrops falling on the roof.

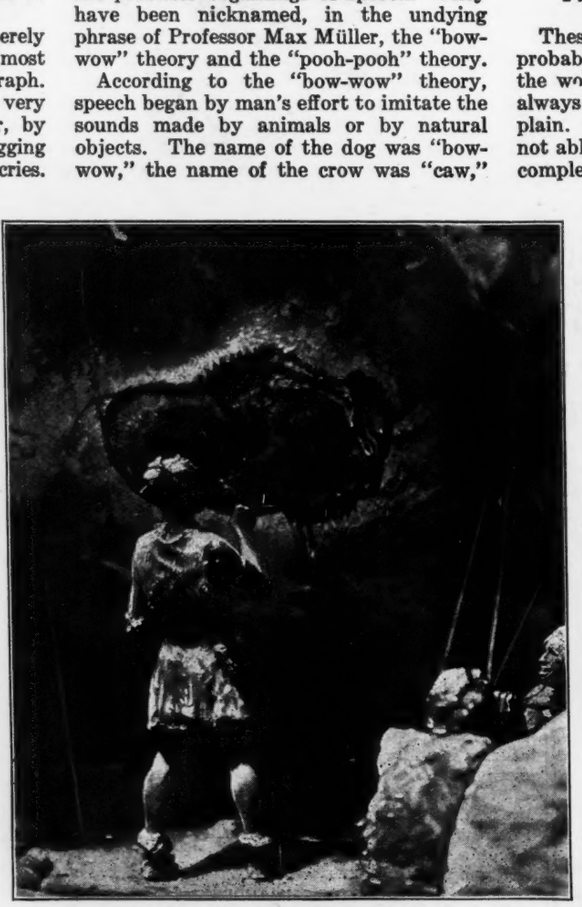
The other theory, the "pooh-pooh" one, attempts to trace all speech back to unconscious cries and interjections like those that we spell out, nowadays, as "pooh-pooh" or "ouch" or "pshaw" or "boo-hoo." It is impossible to accept the idea that all speech arose from such cries, but, like the "bow-wow" theory, this "pooh-pooh" theory has some truth in it. There are undoubtedly, some words which began in this way. Instances are the word "hoot," which has come, quite clearly, from the sound of a loud call, and "hush," which comes from "hiss," and thence from the sound of the quieting or cautionary interjection "s-s-s."

The Natural Growth of Words

These two theories are competent, probably, to explain the origins of most of the words in any language, but there are always some words which they do not explain. This may be merely because we are not able to trace the history of such words completely but it is equally possible, I think, that some of these words of undiscoverable origin may really have begun in different ways, not related either to the "bow-wow" way or the "pooh-pooh" way.

Some may have come, for instance, out of the natural chatter which is so characteristic of monkeys and apes. Other words may have originated in bodily sounds like laughs or sneezes. Still others from the natural and unconscious sounds that accompany various kinds of bodily effort, like the deep panting of a runner or the grunts that we give when we lift heavily on something.

We need not try to trace these word origins in detail. The point that is important in the story of human evolution is that words can be formed in perfectly natural and simple ways; that this great human attribute of speech, so important



A modern artist's conception of the making of a cave drawing in the Old Stone Age. At the left is a drawing of a woolly rhinoceros, and at the right a drawing of a mammoth, as sketched by Old Stone artists.

A story teller in the days when speech was being invented and when gesture took the place of words

for all that man has done and hopes to do in the world, may have grown up, naturally and gradually, just as all the other human attributes have done. The hypothesis of a special creation is no more necessary for speech than it is for the origin of man himself.

When and where these natural beginnings of speech took place we do not know and it is doubtful if we will ever learn. Undoubtedly they are very ancient. Probably they are even pre-human. The men of half a million years ago, whose tools and fireplaces we have found under the gravel beds of the Great Ice Age, must have had some beginnings of speech, though perhaps little more than beginnings.

Even the living apes and monkeys have some characteristics which may be remnants of those early days when speech was beginning. Some kinds of baboons go about commonly in flocks or herds and have a leader; they can recognize his orders and obey them. These orders are given, of course, partly by gesture and by example, as when the leader baboon merely runs off and all the others follow him. But it seems also that there are certain recognizable cries which are understood by all the animals within hearing.

Professor Garner, who spent many years in studying the cries and habits of monkeys, came to the conclusion that they know and use regularly a certain number—about thirty—real "words;" sounds, that is, which they recognize always as standing for the same definite idea. This theory has not been accepted very completely but there is nothing impossible about it. Thirty words would scarcely make a monkey "language," but the use of such distinct sounds, if they are used, would be important for the theories of the origin of speech.

© Drawings MacMillan Co New York

Two figures, presumably devils, from an ancient rock carving in Sweden. From Burkitt's *Prehistory*

We must remember, too, that speech is only one way, though the best one, for animals to communicate with each other. Communication by gesture is much used and probably is more ancient. Facial and bodily expression, the meaning of bared teeth or wagging tail, are still more ancient and universal.

Even we ourselves have not lost these powers. We need no words to tell us that a man is angry or afraid or pleased. Expression and gesture are sufficient, even today, for much of human intercourse. I have been among Indians who spoke no word of my language, nor I of theirs. Yet I got food quite easily by the simple gesture of pointing to my mouth and working my jaws.

It is curious, by the way, that the very ancient root-word for "eat" in the oldest known languages of the Aryan or Indo-European language family (to which family English belongs) is the sound "ad." Repeat this root-word to yourself several times in quick succession and you will notice that the mere production of the sound compels you to move your jaws apart and together just as you do when eating.

May it not be that we have in this fact a clue to the origin of this very ancient word? The ancient savage who wanted something to eat or wanted to describe the fact of eating, made the gesture of moving his jaws, just as I did with my Indian hosts. At the same time the savage made, we may suppose, some kind of noise to attract attention. He uttered, perhaps, the long drawn-out vowel sound "a-a-ah." The combined result of this sound and this gesture was, inevitably, the sound "ad-ad-ad-ad."

Men not only *exchange* ideas by means of words, they *form* ideas by the same means. This is reason enough, though we have many other reasons, for believing that the beginnings of language are very far back in human history, probably even back of the man-like apes that lived before the Great Ice Age. A few words of speech had been invented, probably, even before stone tools were used and before fire was discovered; in the times, that is, of more than a million years ago.

The First Picture Writing

The beginnings of writing were hundreds of thousands of years later than this.

The first writing ever made by man was in pictures. As early as eighteen or twenty thousand years ago the artist-hunters of the Old Stone Age, whom we told about in an earlier chapter of this serial, were making on the walls of the French and Spanish caves a collection of paintings and engravings which still excite our admiration.

We do not know why these cave paintings were made. Presumably they had some magical or religious significance. Many of them are inside of dark and narrow passages where no outdoor light can come. We have found some of the burnt torch-ends and little hollowed-out dishes of stone for grease-fed lamps, by which the artist or his visitors got themselves the light by which to work or to inspect what had been done.

Though we are accustomed, in modern phrase, to talk about these men as cave-men we must remember that they did not live in caves or did so only rarely. Caves were their fortresses in times of attack, their meeting places for religious or other ceremonials. The daily dwellings among most of these primitive peoples were rude huts or dug-outs like the modern cyclone cellars, built along the banks of streams where water was easily available. Sometimes men lived under the shelter of projecting rocks or in the *mouths* of caves, but never in the more gloomy depths within. When they penetrated these depths they did so for some special purpose, not as a matter of daily life. Yet it is in these deeper

Conventional reproductions of the human form, from ancient cave paintings. Note the similarity to a typical child's drawing of to-day

parts of the fascinating European caverns that most of the cave paintings have been found. It is extremely unlikely that men would have crawled into these uncomfortable and terrifying places and have made pictures in them merely for the fun of the thing.

The Writing of Ideas

They must have had an object. The paintings must have been intended to represent an *idea*, to convey this idea either to humans who might see them or, what is more likely, to some supernatural spirit whom the artist hoped would see and note what had been drawn. It is very probable that these cave paintings of so many thousands of years ago are really prayers, the first written prayers that we know anything about.

Whatever they were, they represented, we may be sure, some kind of an idea and this, you notice, is also the object of speech. Speech is a way of communicating ideas. So are pictures. Picture writing is a sort of substitute for speech.

Among the American Indians, before they were displaced by the whites, there was a large number of different spoken languages. Only rarely could one tribe understand the speech of another tribe. But the writing of the tribes, the only kind of writing that they had, was a picture writing and *everybody understood it*. A piece of thin bark with a rude drawing of a hunter and the number of buffalo he had killed—a kind of aboriginal picture postcard—would circulate quite intelligibly from one coast of America to the other. Men of every tribe could read off the *idea* though each tribe would read it in a different *speech*.

Modern writing differs essentially from this. It is a writing of *speech*, not of *ideas*. Let us see just how this modern method developed out of the primitive picture writing.

The World's Earliest Writings

The oldest known written language is that of the first civilized inhabitants of Babylonia, the people whom we call the Sumerians. As early as 4500 B. C. these people lived in cities and practiced irrigation and had priests and kings. They had a kind of writing that they scratched on stone or on brick-like tablets of burnt clay. Some of the surviving examples of this earliest known written language are probably more than six thousand years old.

It is clear that this writing of the ancient Sumerians was originally a kind of picture writing much like the picture writing of the American Indians. The idea of God, for example, was represented, in the earliest Sumerian inscriptions, by a picture of a star. This meant, of course, a heavenly being, for in those days all the stars were thought of as being alive.

Similarly the idea of a field was represented by a rough oblong, with several cross lines to indicate the irrigation furrows. The idea of a hand was represented by five short horizontal lines repreresenting the outstretched fingers. And so on. This earliest writing had, so far as we can see, no relation at all to speech. It was merely a representation of natural objects or of ideas associated with them. To understand just what this meant let us suppose that we were still writing this way, that an English-speaking people were using a picture language like that of the ancient Babylonians.

The written sign of the eight pointed star represented, as we have seen, the *idea* of God. It did not represent the word "God," This same idea-sign might be read off by different readers or at different times by any word that stood for that idea; by "Lord," for instance, or by "Holy Spirit" or by "Creator" or "Heavenly Father" or any other one of the many words which stand in speech for the idea of the deity. Similarly the idea-sign for field might be read off as "land" or "farm" or "ranch" or any one of a dozen other spoken words.

This was good enough so long as writing was used only for magical formulas or for inscriptions in the self-praise of kings. But the Babylonians were becoming a commercial people; they were beginning to import and export goods, to buy and sell widely, to pledge credits and to make all manner of business contracts.

Signs Begin to Represent Words

For such matters a simple, more or less indefinite, picture writing would not do at all. If a man mortgaged his farm it was necessary to have an unmistakable record of just what farm it was.

Speech, of course, was much more definite. Two people talking together could say "farms" quite unmistakably, so that each understood exactly what the other meant. And so it seems to have occurred to some Babylonian genius that he could use the picture-signs already familiar in the inscriptions in which to set down words; that he could make thus a record of the actual spoken words of a contract, not merely a more or less hazy picture-reminder of its *ideas*.

The sign, for instance, of the eight-pointed star came to stand for the *word* "God," not for the idea. It would be read off in speech always by this word, never by any other word, no matter if that other word did happen, like "Lord" or "Creator," to express the same idea. The original idea-signs of the writing had become word-signs.

Syllable—Signs Developed

The next step in the development of a real writing was to identify the sign with the mere sound, not even with a word. The sound of the syllable "god," for instance, is part of the word "godsend," of the proper name "Godfrey," and so on. So when the Babylonians wanted to write a word like "godsend" they would set down first the eight-pointed star which had come by now to mean the sound "god" and then follow it with a sign standing for the sound "send." The recipient would then read off "god"-"send," as he was meant to do. The word-signs had become syllable-signs.

That was as far as the Babylonian writing ever got. Each separate sign in it (there were thousands of them) stood for one syllable. Words and sentences were written by putting these syllable signs together one after another.

Modern writing has taken still another step toward simplicity. It has become alphabetic. We write, for instance, all the 300,000 or 400,000 words of English with only 26 letters. Each letter of the

(*Turn to page 84*)

Caterpillars Troublesome 5000 Years Ago

THE stone tablet shown above is about 5000 years old. The inscription is written in the earliest known form of the Babylonian picture writing and describes the attempted removal, probably by a magical incantation, of caterpillars that were attacking certain fields and orchards. Note the sign of a jug turned on its side which occurs near each of the upper corners. The sign for a star (or god) occurs near the upper left hand corner.

Below is a tablet of a later period, written on baked clay about 4200 years ago after picture writing had become much conventionalized. It enumerates certain supplies, mainly jugs of different kinds of oil, intended for the use of the temple at the great Babylonian city of Nippur. The conventionalized form of the star shaped sign for god occurs just before the middle of the second line and also as the first sign of the fourth line, as shown below

Origin of one letter of our alphabet, showing how "A" has developed by gradual stages out of the ancient Egyptian sign of the eagle, or hieroglyphic

Power Plant Corked in Pocket Flask

Gas Pressure in New Eight-Inch Bottle Lifts 15 Tons; Fills Auto Tire in Three Seconds

A SMALL steel bottle, scarcely larger than the familiar hip-pocket flask, yet by the turn of a valve, capable of releasing power sufficient to lift a street car from its tracks or tear the walls of a building from their foundations.

Such is the amazing new pressure device, invented by Walter S. Josephson, a mechanical engineer, and which was given its first public demonstration in New York recently. During this exhibition, a ten-year-old girl placed a special jack beneath a five-ton motor truck, attached the power bottle to the jack and turned the valve. Three seconds later the bottle had lifted the forepart of the great truck in the air as readily as a woman might tilt a baby carriage.

Designed for Many Uses

Astonishing as this demonstration was, the inventor says it revealed only one of the wide variety of uses to which his miniature storehouse of energy may be turned, including tire inflation, refrigeration, and fire extinguishing. For his steel flask, in its present size and form, Mr. Josephson claims a lifting power of 30,000 pounds.

The flask derives its amazing power from liquid carbonic acid gas with which it is filled from large cylindrical tanks under a pressure of 1000 pounds. The gas is highly expansible, and when it is released suddenly from the flask through a valve into a cylinder, it exerts a tremendous pressure upward upon a piston, through which it exerts its lifting power. Its use for refrigeration and the extinguishing of fires depends on special chemical properties of the gas.

The flask itself is of steel, pressed from a single disk. It is made in two sizes—in lengths of eight inches and of thirteen inches—and weighs, depending on the size, from three to three and one-half pounds.

When attached to a special tire pump, which has a gage and valve preventing the escape of more pressure than is necessary, the bottle, it is claimed, will inflate an automobile tire in three seconds. Used with a special liquid container, it may be used to manufacture and chill carbonated beverages for home use. The inventor also is designing refrigerating coils which may be used in conjunction with the bottle for freezing ice cream, and supplying refrigeration for ice boxes, fruit cars and for medical purposes.

He expects to retail the bottles at prices any one can afford and to refill them for a nominal charge. Such auxiliary apparatus as automobile jacks, tire pumps, fire extinguishers and bottles for carbonating beverages, he says, will be obtainable for a few dollars. Refrigerating apparatus will be more elaborate and more expensive. An eight-inch flask, he says, can be used about 10 times for purposes such as jacking up a small touring car before it need be refilled.

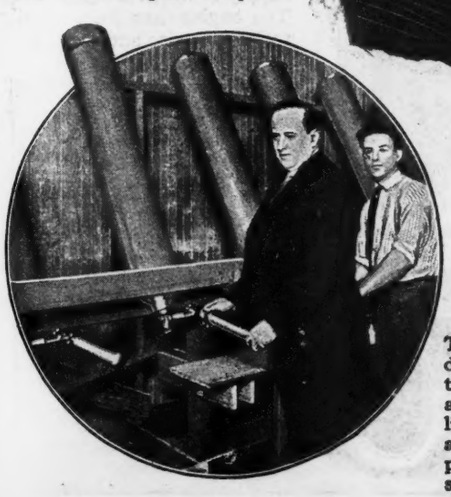
The inventor expects his flask to come into widespread use among motorists, in the home, and in various trades where there is constant fire hazard or need for apparatus capable of developing great lifting power. One use which he has suggested is for street car crews or the police in releasing persons imprisoned under cars or placing derailed cars back on the tracks.

Utilizing expansible liquids for storing up and releasing power, he says, is no new principle; but he asserts that his device is the first of the kind to be made in a size capable of being carried in a man's pocket and the first which can be manufactured at a low price.

The flask is made to withstand 10 times the pressure of its contents, so that it is safe to carry. The United States Government will permit it to be shipped by mail, express or freight.

Blowouts lose their terrors when a power bottle is handy. This marvellous little storehouse of energy will lift an automobile clear off the ground two seconds after a jack is placed beneath it

Working with the aid of a large jack, the power bottle lifts a 15 ton girder in about two seconds



The large cylinders from which the power bottles are filled with liquid carbonic acid gas under pressure are shown at the left

For the automobile camping trip or for a day's outing, this ingenious little flask carbonates and chills refreshing drinks on the spot

Exciting Moments Double the Weight of Crowds

RECENT investigations of the stresses set up by the movements of live loads have revealed the surprising fact that men and women, when they are excited, weigh twice as much as when they are sitting quietly.

This fact is taken into consideration by construction engineers in building large grandstands to seat thousands of persons at the races or at football and baseball games. The stands must be designed to support increases in load when crowds suddenly stand up, lean forward, or sway together in their excitement.

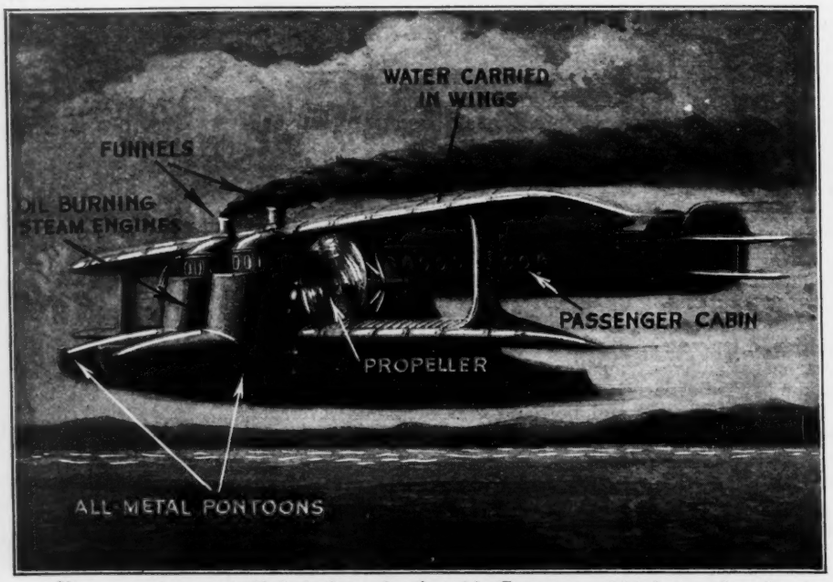
During tests made by a professor of engineering, a man was placed on the platform of a scale in a crouching position, then told to stand up. As he did so, a reading of the scale showed that his weight had increased 67 per cent. Arising from a chair added 79 per cent. When the man suddenly straightened up from a crouch and at the same time brought his arms down, the scale showed that he had momentarily added 174 per cent to his weight; in other words, that his weight had increased more than 2½ times.

A man rising suddenly exerts not only this powerful downward force, but a horizontal force as well.

Experimenting with Steam Airplane

REMARKABLE though its development has been in the last dozen years, in one important respect the science of aviation may be said to have remained virtually at a standstill since its infancy, and that is in the type of engine used to furnish the the motor power for aircraft.

The airplane of today bears scant resemblance in outward features to the first successful machine of the Wright brothers; new types of wings, rudders, propellers and bodies have been devised; but the motive power still is furnished by an internal combustion engine—an improved engine, of course, but one which still retains the element of undependability.



The new steam-propelled airplane, developed in Germany, which is arousing the interest of American aeronautical engineers seeking to develop better engines

The recent record breaking long distance flights of the army aviators, Lieuts. Oakley G. Kelly and John A. Macready, who flew from coast to coast without stop, indicated that while the body of the modern airplane is sound, its heart—the power plant—is weak and constantly giving trouble. Navy Department statistics show that the Liberty motor must be overhauled after approximately 72 hours of flight, at a cost of 300 man-hours—more than $600. The navy now is concentrating its attention on the improvement of engine reliability.

Aeronautical engineers long have recognized that the development of a motor that will combine lightness of weight with high power efficiency but that will lack the uneven performance of the present internal combustion engine probably is the principal problem confronting them in pushing the commercial possibilities of aircraft. Until recently their experiments have supplied no definite hope of finding an effective substitute for the present engine.

Steam Plane Is Possible Solution

From Germany, however, comes a report of the development of a steam driven airplane. Although this craft is still in the experimental stage, accounts of its performance and the description of its operation have been received by American aviation engineers with tremendous interest. In fact, some profess to see in the new German plane the first step in the solution of the problem of furnishing an absolutely dependable motor for the commercial aircraft of the future.

The steam plane is constructed throughout of duralumin, the extremely light aluminum alloy which has been used successfully in airplane construction in this country. The engine is an adaptation of the Diesel engine, now extensively employed in the United States Navy. It burns a combination of crude oil and other oils, which is broken up under a forced air feed and sprayed against the boiler. Here it ignites, giving terrific heat considering the relatively small quantity of oil consumed in the operation. Ten gallons of oil are said to be sufficient to run the plane's 750 horse-power engine for eight hours. American aviation engineers are inclined to question this statement, as well as the report that only 1,000 pounds of water are used in a flight of 95 hours, although they agree generally that the principles employed in the new plane are sound and are likely to lead to important developments.

The steam turbine and boiler are said to be considerably lighter than other engines capable of developing equal horse power. It is claimed also that the new plane will carry much less weight in oil and water than the weight of gasoline carried by an ordinary airplane of the same size, equipped for a flight of equal duration.

The water used to generate steam in the new plane is carried in the metal wings, in compartments so arranged that the water may be shifted to "trim ship" if desired. The steam is condensed after exhaust and conveyed back to the wings in the form of water.

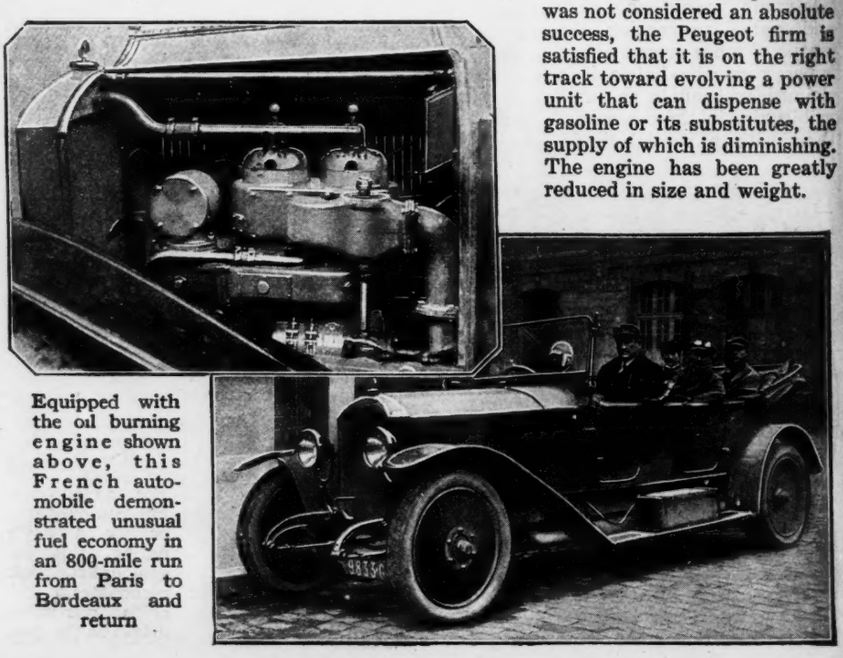
George W. Lewis, M.E., executive officer of the National Advisory Committee on Aeronautics, says that the U. S. Government has done considerable experimental work on steam power for airplanes but has met with only partial success because of the problem of condensing water without the use of heavy equipment. For the heavier than air machine he believes steam power does not look encouraging at this time but ultimately it will be of considerable use in the propelling of rigid dirigibles. Lewis and other aeronautical engineers in the navy agree that steam is the apex of efficiency and that its thorough reliability under practically every condition makes it a fertile field for experimentation.

New Auto Engine Burns Oil for Fuel

IN a demonstration staged recently by the French automobile firm of Peugeot an automobile burning heavy oil exclusively made the trip from Paris to Bordeaux and back.

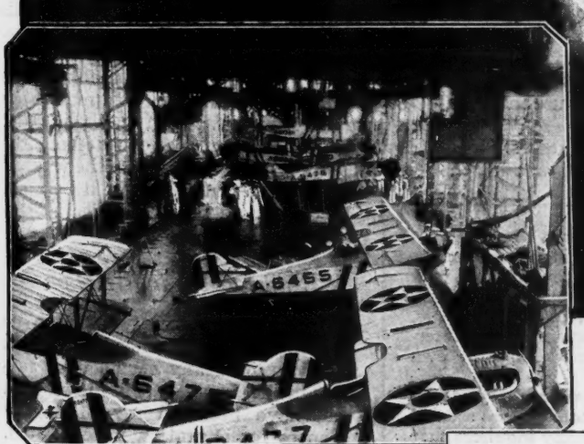
Not a drop of gasoline was used throughout the journey of nearly 800 miles. The average speed was 40 miles an hour, and the fuel consumption was about 15 miles to a gallon. The running cost is reported to have been only one-seventh to one-ninth that of the average gasoline-engined car.

Although the experiment was not considered an absolute success, the Peugeot firm is satisfied that it is on the right track toward evolving a power unit that can dispense with gasoline or its substitutes, the supply of which is diminishing. The engine has been greatly reduced in size and weight.

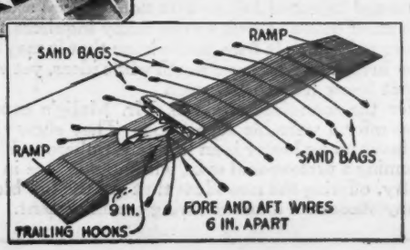


Equipped with the oil burning engine shown above, this French automobile demonstrated unusual fuel economy in an 800-mile run from Paris to Bordeaux and return

Liners of Tomorrow May Be Flying Fields



ABOVE is the well deck of the U. S. S. Langley, aircraft carrier of Uncle Sam's navy, showing how planes are stored. The diagram shows new arresting gear designed for the Langley's flying deck. On a revolving platform are stretched fore and aft and athwart-ship wires. Hooks from a landing airplane engage these wires, halting and holding the plane.



WITH transatlantic travelers clamoring for more speed in crossing the ocean and with the business world demanding quicker delivery of over-sea mails, naval architects and airplane designers have combined efforts to perfect a successful aircraft-carrying passenger steamship. Their design of the luxurious ocean liner of tomorrow is pictured above. Like the U. S. S. aircraft carrier Langley, it has a top flying deck unobstructed by fixtures, so that mail and passenger planes can take off and alight while the ship is at sea. Two elevator hatches are provided so that arriving aircraft can be lowered to a well deck that serves as hangar. With passenger ships serving as safe landing fields, a passenger bound for Washington, could be landed at his destination before the ship docked at New York.

How I Make Inventions Pay

The Personal Experiences of One Inventor Who Overcame Many Failures by New Methods of Marketing His Creations

By Frank Mulig
Inventor of Small Toys and Novelties

IS THERE money in inventions—for the inventor?

I refer not to the great epoch-making inventions that alter the course of history, such as the telegraph, the steamboat, and the airplane. Everybody knows that fortune and fame usually reward the maker of revolutionary mechanical discoveries. Rather, I am talking about the invention of small things—toys and novelties, simple labor-saving devices, improvements in articles of everyday use. Is it worth while for a person of inventive bent to devote his time and his wits to the development of things of that sort? Will he find it profitable?

Lives by Inventions

My answer to the question is an almost unqualified "yes," and I base my reply on my own experience. I am an inventor. I am 37 years old, and since boyhood I have made my living almost entirely from simple inventions. I have had failures; some of my inventions I have been unable to sell for enough to pay the cost of the patent papers. But I have managed to keep going, and now I think I can say I am prospering in a modest way. I have a good job with a going concern, which manufactures and sells articles of my invention. I own some stock in the concern. I have a bank account.

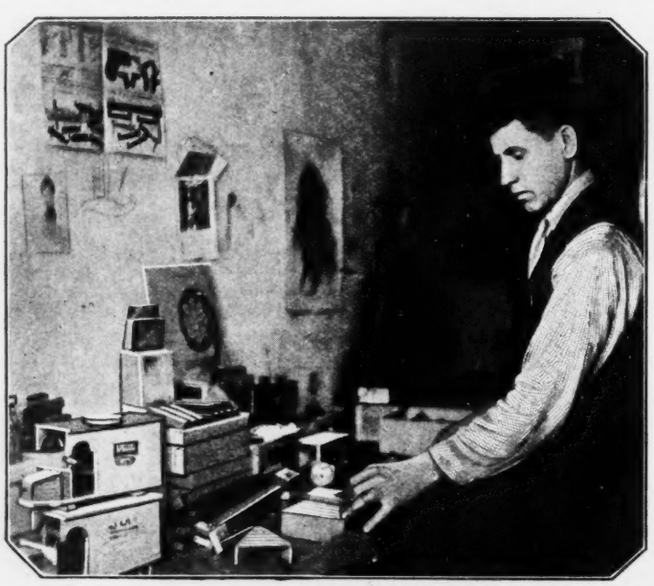
Success Follows Repeated Failures

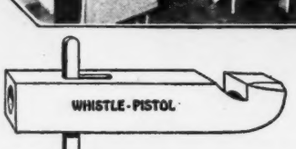
Such success as I have gained is entirely due, I think, to my method of realizing on inventions—a method that I put into practice after repeated failure to sell the patent on an article in which I had faith, but which for two years I had failed to dispose of. I am going to tell the story of that invention, and in doing so I hope to pass along to other inventors—especially young inventors—the secret of the method which I found successful.

Anyone can do what I have done. I know it, because it requires nothing beyond the qualities which all inventors must have—patience, perseverance and a willingness to work. I have done the thing successfully, not only in the instance of which I am about to tell, but at other times before I formed the permanent connection which now supplies me with a market for all my inventions.

The article which I invented and was unable to sell was a wooden whistle. That certainly is about as simple an invention as one might devise. My principal claim to originality lay in the fact that I had designed the whistle, which was also a pistol and had equipped it with a trigger, which, when pressed, caused a loud report. In addition, the whistle could be used by small boys as a bean shooter.

"Here is an article with a noise-maker at each end," I thought; "something that every boy will want."





Frank Mulig, inventor, at his workbench in the factory where he is superintendent. At the left is his whistle-pistol which he marketed after 1000 manufacturers had turned it down

But the manufacturers of toys and advertising novelties, to whom I submitted my invention, failed to agree with me on that point. In the course of two years I offered the article to more than a thousand concerns by letter and personal call. Nobody wanted my whistle-pistol even as a gift. It seemed, at last, that I was through. The only two ways I knew of marketing an invention were selling it outright or on a royalty basis; for, like most inventors, I had no money of my own to use in manufacturing it.

Then, when I was thoroughly discouraged, I conceived an idea for a third method, the method that brought success. It was this:

I estimated as closely as I could the cost of manufacturing and selling my article on a quantity basis. Armed with these figures, I started out to try again—not with an idea of interesting manufacturers but of finding some one who might be willing to invest money if promised a return of 20 per cent. The very first man I interviewed gave me $150 for a third interest in my patent. Within a week he disposed of his share for $300 and the buyer thought enough of his bargain to pay me $500 for an additional one-sixth share, which made us equal partners.

A Substantial Profit

We began manufacturing, and continued to do so profitably for about a year. In the meantime I had developed a few other inventions, which I decided to dispose of in the same manner, so I sold my remaining half interest in the pistol-whistle for $500, which netted me a clear profit of $1150 on the invention which nobody would buy, in addition to manufacturing profits.

I was successful in finding capital for my other inventions and had begun to manufacture them when one of the partners in the whistle-pistol enterprise died. The survivor, believing he had not the experience to conduct the business alone, requested me to try to dispose of it for him. I did so, receiving a commission of $300 when I found a purchaser. This brought my profits on the whistle-pistol up to $1450.

The purchaser incorporated for $15,000 to manufacture my whistle-pistol and made me an attractive offer to superintend his plant and to develop additional inventions.

I accepted his offer and also used my savings to buy considerable stock in the new company, which has placed many toys and games of my invention on the market, and which has been successful from the start. So, counting everything, the whistle-pistol which nobody would buy has brought me a profit of several thousand dollars.

Satisfaction in Creation

All of this I have written in no boastful spirit. I do not believe that I have scored any conspicuous success in life. I am a small town man and have been all my life. My chances for education were limited. But I believe I can say that I have made the most of my limited talents.

Anyone can do likewise—whether he is an inventor, clerk, mechanic, or laborer. Don't let failures discourage you. You may not make much money, but there's a self-satisfaction that is priceless in the realization that you have done your best.

EVERY month POPULAR SCIENCE MONTHLY receives scores of letters inquiring whether there is profit in small inventions. In the same mail with a handful of these inquiries there arrived, not long ago, a letter from Frank Mulig, of Ottawa, Ohio, containing the accompanying account of his interesting personal experience in marketing his own inventions.

Mr. Mulig's modest, straightforward story of how he turned repeated failure into final success seemed such an effective answer to our many inquirers that we are publishing it here in the hope that it may aid other inventors who have worth while ideas, yet who do not know how to sell them.

For the manufacturer, too, Mr. Mulig's experiences offer a valuable suggestion. They show that the inventor no longer is an itinerant tinkerer. He is becoming a professional man, with a real place in industry, offering the new ideas that are the life blood of any successful manufacturing establishment.

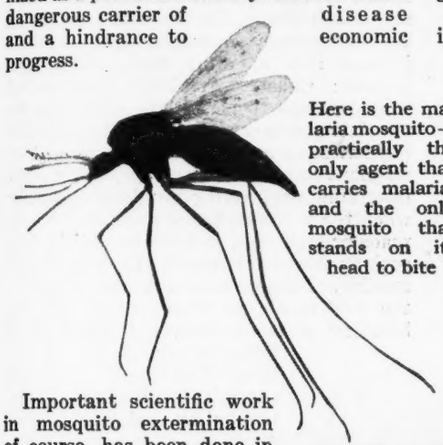
Have You a Mosquito Farm at Home?

How to Stamp Out Summer Joy Killers

By Abram H. Cornish

Member of the Essex County, New Jersey, Mosquito Extermination Commission

YOU probably are complaining bitterly about the mosquito this summer. But what are you doing to eradicate the pest? Nothing, if you are like most other men. And yet, were it not for this carelessness and indifference, which dates back into antiquity, the mosquito might have been stamped out from the civilized world ages ago. Clearly, man is responsible for the continued existence of the many breeding places of this destructive insect, long recognized as a pest and nowadays known to be a dangerous carrier of disease and a hindrance to economic progress.



Here is the malaria mosquito—practically the only agent that carries malaria, and the only mosquito that stands on its head to bite

Important scientific work in mosquito extermination of course, has been done in the last twenty years or so. The United States Government succeeded in virtually controlling mosquito breeding in the Panama Canal zone, Cuba, and in the areas occupied by army training camps for troops during the European war. In New Jersey 140,000 of the 296,000 acres of salt marsh land in the state have been drained, and 60 per cent of the mosquito breeding places in the uplands have been eliminated in the warfare against the mosquito. Essex County, New Jersey, alone is spending about $70,000 in mosquito control work this year. Similar expenditures of money and effort are being made elsewhere in the country.

Yet all the work of mosquito extermination thus far has been carried on by professional workers under the direction of scientists employed by the national government, the states, the counties, and the municipalities. Strange to say, the public as a whole still remains indifferent and careless to this menacing insect enemy, even though the methods by which every man, woman and child might render signal aid in the control of the mosquito are simple and easy to follow.

The mosquito breeds only in water. Therefore, if you prevent water from standing about your premises, you make it impossible for the mosquito to breed. Rain barrels, cisterns, water pails, tubs, cellar excavations, small depressions in the ground—all furnish the mosquito with adequate places in which to deposit its eggs and bring into being great swarms of pestiferous insects. Foul, polluted water that stagnates in cesspool overflows and house sink drains, permits the mosquito to breed in abundance. The typical city corner sewer basin, where dirty, stagnant water may lie for weeks is a veritable haven for the mosquito bent on propagating its species.

So, if you would aid in the work carried on for your protection and comfort by public employes, it is necessary for you only to heed the following simple rules:

Do away with your rain barrel—unless you absolutely need it. If you do, see that it is securely covered.

Get rid of all old cans and bottles.

Examine your roof gutters against stoppage.

Fill up any low spot about the premises.

Throw a cup of kerosene or crude oil in the cesspool every fifteen days.

When closing your house for the summer, pour a little kerosene into bathroom bowls and laundry drains.

Screen your open fire place, or stuff well-rumpled paper into the chimney.

Screen or paste paper over all ventilators.

Flush unused waste bowls occasionally.

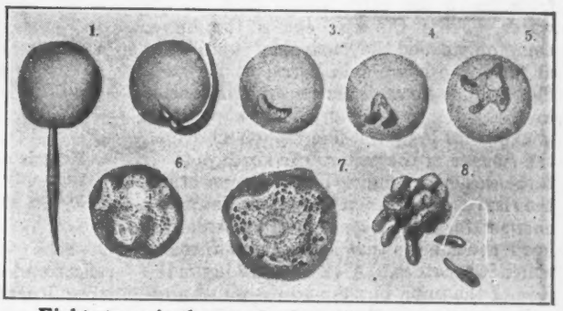
If the problem of mosquito-breeding near your home appears too great for your efforts or facilities, communicate with your local health authorities or mosquito extermination commission, if there is one

Possibly it would be well to state here that a campaign of the "swat the fly" variety would be useless against the mosquito. Mark Twain in "Roughing It"

ANTENNAE, OR FEELERS
MAXILLARY PALPI OR SUPPLEMENTARY FEELERS
FEELER TO GUIDE THE PROBES
LABRUM, OR PROLONGED UPPER LIP
HYPOPHARYNX, OR SUCKING TUBE
MANDIBLES, OR CUTTING TOOLS
MAXILLAE, OR SAWS
LABRUM, OR PROLONGED LOWER LIP
SECTIONAL VIEW OF THE HUMAN SKIN

How the mosquito attacks us. This illustration, magnified nearly 200 times, shows the sharp cutting tools and saws used by the insect to pierce the tough outer layer of skin and to prospect for blood beneath. The cut-away view of the head above shows the complicated apparatus for pumping blood through the sucking tube

Above is a highly magnified sectional view of the human skin, showing how the mosquito cuts through the tough outer skin and quickly probes through the sensitive inner skin to the blood wells below. The dark circle is an artery—the objective into which the long sucking tube has penetrated



Eight stages in the attack of a malaria parasite on a human red blood corpuscle. The parasite enters, multiplies, and finally destroys the corpuscle

describes a stout lady conducting a mosquito extermination campaign of her own in the Overland Mail Coach by extending her well-rounded arm as bait and slapping the mosquitoes as they alighted. The same amount of energy used by this lady in doing one mosquito to death would have been equal to destroying thousands if applied to the breeding place.

There are many varieties of the mosquito family. One is the carrier of malaria, another transmits yellow fever, a third interrupts your slumbers at night, still another pest seems to rise from the ground in the evening to drive you from your porch. Each of these groups may be subdivided again, but a description of the species in detail is beyond the scope of this article.

The common house mosquito, yellowish to dark brown in color, with a whitish band at each segment of the abdomen. It breeds in stagnant water and has a lean look

Water Is Breeding Place

In appearance and habits these various groups differ in many details, yet they have one common characteristic, of paramount importance in controlling them—all breed in water, *and in water only*. Were it not for this fact the problem of mosquito extermination might be insoluble.

In the water which you permit to remain near your dwelling breeds the mosquito that probably is most familiar to you—the house mosquito, a medium-sized insect, yellowish to dark brown in color with a narrow whitish band at each segment of the abdomen. It is slight, not especially hairy and has a lean and hungry look befitting its habits and temper.

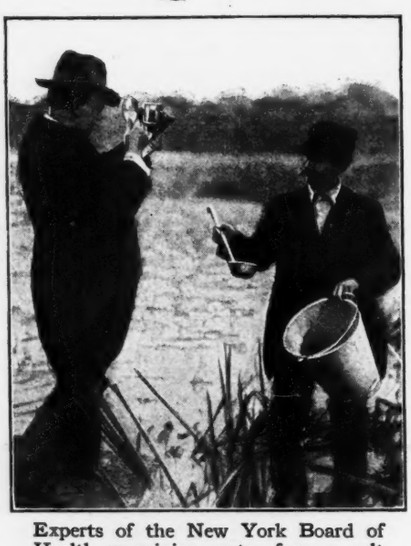
The female of this group passes the winter hiding away in cellars or similar protected places, sallying forth in spring to deposit her eggs wherever stagnant water has been permitted to collect. Since the successive stages by which the house mosquito develops from the egg are fairly typical of the development of all mosquitoes I shall describe the process briefly.

The eggs are laid in small black masses of from 50 to 400 each, which float on the water. From the egg comes the larva, commonly called the "wriggler," familiar to anyone who has a rain barrel at his back door. This larva feeds on organic matter in the water and gets its air supply by sticking its long tail-like siphon above the surface of the water. In six days to three weeks, depending on the temperature, the larva becomes a pupa, a decidedly changed form, with curled tail and enlarged head containing two little horns through which it breathes. After 24 to 72 hours the skin of the pupa bursts and the adult mosquito emerges in the form with which we are familiar. Pausing only until its wings dry, it flies away to carry on its annoying work.

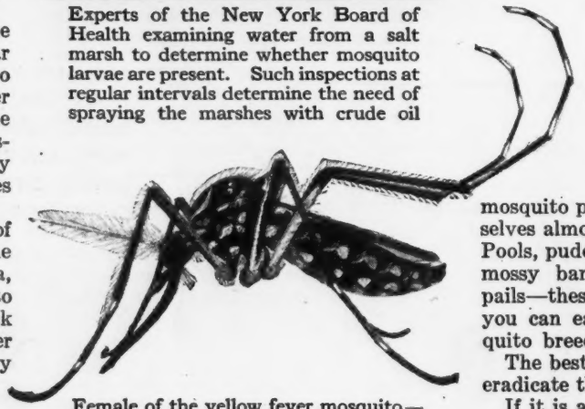
"Jersey Mosquito" Famous

The house mosquito is to be found around every human habitation, and it evidences an ingenuity and persistence that are almost admirable in its effects to get inside the house. It will fly down chimneys and up through cellars, squirm through window screens and door cracks; in fact, it will use any means of entrance sufficiently wide to admit its slender body. Once in, it is exceedingly difficult to get out, and only a few of these pests are required in a house to make things miserable for a whole family.

Belonging to the house group, but differing from the insect described above, is the malaria mosquito which is practically the only agent which transfers malaria from infected persons to well persons. This insect is brownish-black in color and has four brownish-black spots on each wing. The female, winters in cellars and similar places as does the house mosquito, and its cycle of life is similar. It is distinguished from all other mosquitoes by its manner of biting. It holds its body perpendicular, virtually standing on its head, instead of holding it almost parallel to the skin surface as other mosquitoes do. This insect breeds in clear, clean water. Breeding is continuous from spring to fall, but it is especially active during midsummer.



Experts of the New York Board of Health examining water from a salt marsh to determine whether mosquito larvae are present. Such inspections at regular intervals determine the need of spraying the marshes with crude oil



Female of the yellow fever mosquito—the only known means of spreading yellow fever. Only the female bites

The insect that has won doubtful fame both for itself and for the State of New Jersey, known as the "Jersey mosquito," belongs to the salt-marsh group. It is a large, robust insect, either brown in color or with body marked with alternate black and white stripes. A day or two after hatching it begins its migratory career, finding a home in gardens and lawns but rarely entering houses. This group constitutes an obvious economic menace, for it makes uninhabitable vast tracts of swamp land that otherwise might be reclaimed for industrial or dwelling purposes.

The inland-swamp mosquito, as its name implies, breeds in fresh-water swamps in all parts of North America, wintering in the egg in the mud of the pool in which it breeds. This is a small insect with narrow white bands at the joints of the legs and a noticeable indentation in the white markings of its abdomen. It is especially prevalent during rainy seasons for it is quick to take advantage of temporary rain pools as well as permanent swamps.

Means of Eradication

As has been stated, all successful mosquito control work is directed at the breeding place; but, since the breeding places have been shown to vary, each branch of anti-mosquito work presents its own problems, although the same underlying principles apply to all.

In New Jersey our principal problem naturally comes from the control of the salt-marsh group, for the salt marshes of the state occupy thousands of acres. This is true also of other states along the Atlantic Coast. Artificial drainage of these swamps to permit the tide-water to circulate and to carry off the water from the highlands, so as to reduce the amount of stagnant water in the swamps, becomes an interesting engineering problem, especially when the salt marshes are cut off by railroads or highways, or have been settled to such an extent that gravity drainage is not feasible. Filling also is a means of ridding the salt marsh of places suited to the breeding of mosquitoes, but the cost of filling large areas is prohibitive. The usual means of control are ditching, diking, tide-gating and filling small areas.

Of course, the general public can not be expected to aid actively in this sort of engineering work. But in the control of the house-mosquito private citizens may make themselves almost as useful as public employes. Pools, puddles, small running streams with mossy banks, rain barrels, tubs, water pails—these, if they are near your home, you can easily make unsuitable for mosquito breeding.

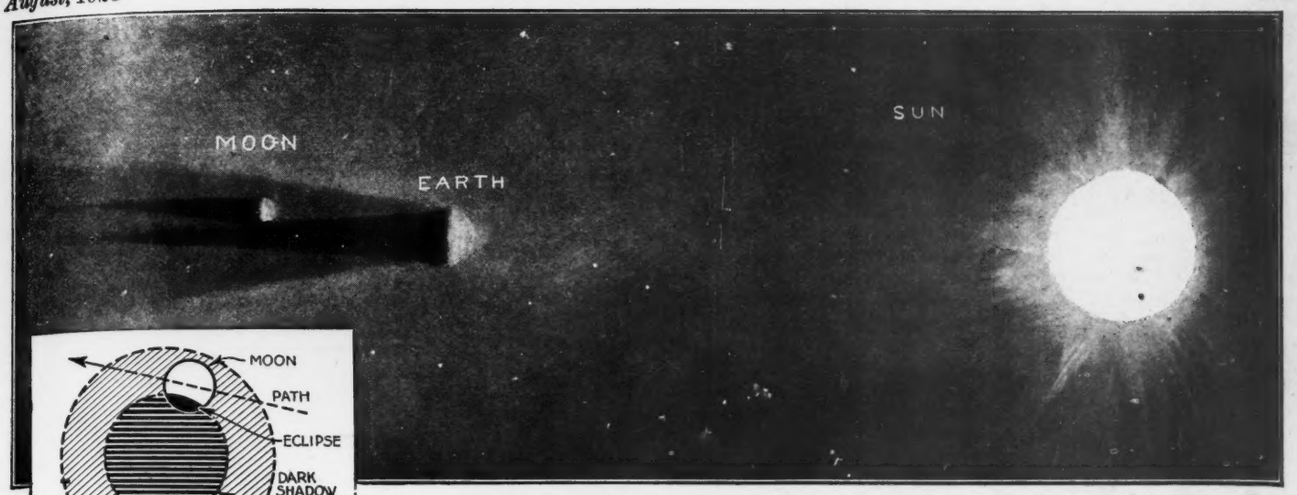
The best and surest way to do this is to eradicate the breeding place.

If it is a rain barrel, dump it; if a tub, overturn it; if a tin can, punch a hole in the bottom of it; if a cistern, cover it tightly; if a cesspool, clean it out and screen it tightly; if a corner sewer basin, oil it completely at intervals of about 10 days during the breeding season.

Oil placed over the surface of a breeding pool kills the larvae, because they cannot penetrate the oil film with their breathing tubes, and they suffocate. For this purpose the distillates of crude petroleum, kerosene and fuel oil, are widely used in mosquito extermination. Special lavacides also have been employed.

Kerosene evaporates readily and is expensive, but it is effective because it spreads rapidly. For the amateur mosquito exterminator it probably is the best means of coping with breeding problems near his home.

If everyone would follow these simple rules the combined efforts of the general public and the professional workers would exterminate the mosquito within a few years.



Position of the earth between sun and moon during the eclipse of the moon August 26. A small sector of the moon is blackened as it passes through the dark conical shadow cast by the earth. The remainder of the moon is dimmed by the earth's penumbra, or light shadow. Diagram at left shows the moon's passage through these two earth shadows, as it will be viewed from the earth

America's View of Two Eclipses

By Robert E. Martin

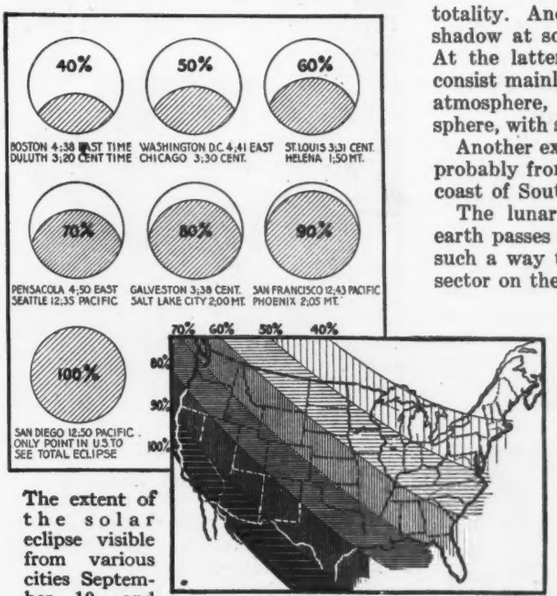
IN THE next month two eclipses, one of the sun and one of the moon, will be visible in the United States. They will occur within two weeks of each other; the lunar eclipse on August 26 and the solar on September 10—a rare coincidence in astronomy.

Total eclipse of the sun, the first to be observed in the United States in five years, will be visible in California only, although partial eclipse will be visible throughout the United States.

A solar eclipse occurs when the moon comes between the earth and the sun, cutting off part of the sun's rays from the earth. In the regions where the axis of the moon's shadow cone strikes the earth this eclipse appears in totality. Since the point of this cone extends farther than the distance from the moon to the earth, there is an area about 150 miles across on the earth from which the sun's direct rays are completely cut off.

The axis of the moon's shadow cone, which causes the total eclipse, will strike the earth at sunrise near Kamchatka, in Asia. From there the path of totality will sweep across the Pacific ocean until it touches California south of Santa Barbara and west of San Diego. It will reach this point about 1 P.M. The duration of the total eclipse there will be about three and a half minutes.

From this point the path passes to Lower California and thence across Mexico to Yucatan. From Yucatan the shadow passes to the south of the West Indies and leaves the earth at sunset to the southeast of Porto Rico.



The extent of the solar eclipse visible from various cities September 10, and the corresponding time of eclipse, are shown above. The shaded map indicates how the moon will cast its shadow on the United States

At two temporary stations and at the home station in Pasadena, Calif., scientists of the Mt. Wilson Observatory of the Carnegie Institution of Washington will observe the phenomenon. One expedition will be located in the path of totality. Another will be at the edge of the shadow at some point east of San Diego. At the latter place the observations will consist mainly of photographs of the sun's atmosphere, scientifically called chromosphere, with spectroscopes of various types.

Another expedition will study the eclipse probably from the Catalina Islands off the coast of Southern California.

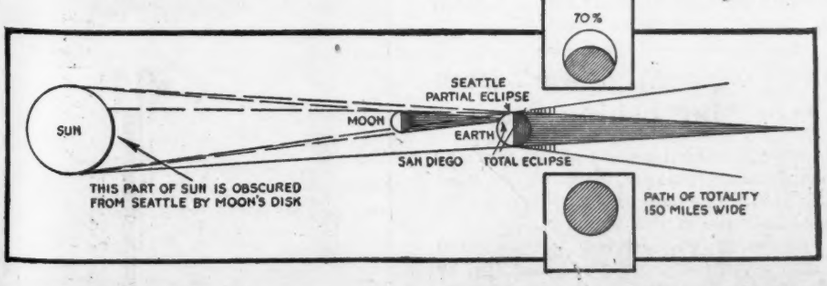
The lunar eclipse is caused when the earth passes between the sun and moon in such a way that its shadow marks a dark sector on the moon's bright surface.

The earth, like any other sphere, casts a shadow in the form of a cone. When the center of the moon passes across the axis of the shadow cone its entire surface is darkened, since the sunlight it reflects is cut off, and we have a total eclipse.

On August 26, however, only the lower edge of the moon will be darkened to observers on earth, because it will not pass through the center of the shadow. It will enter the earth's penumbra, or light shadow, at 2:12 A.M., and the umbra, or dark shadow, at 3:52 A.M. It will advance deepest into the dark shadow at 4:40 A.M., central time, when 17 per cent of its diameter will be obscured. It will leave the dark shadow at 5:27 and pass out of the light shadow at 7:06.

Unlike the eclipse of the sun the moon's eclipse will look the same from every part of the earth. This is explained by the fact that when the earth's shadow is cast on the moon we are in a position between the light and the object on which the shadow falls. We see a dark spot on the moon which is practically unchanged by small angular displacements on the earth because we are part of the object which casts the shadow, with the light behind us.

In a solar eclipse on the other hand, the moon which obscures the sun, is close to us and between us and the sun. With the sun 90,000,000 miles away variations in the displacement on earth allow us to look "around" the moon and see part of the sun. This causes varying degrees of eclipse.



Eclipse of the sun. The moon, passing between earth and sun, cuts off part of the sun's rays. At San Diego, where the axis of the moon's conical shadow strikes the earth, the eclipse is total. At Seattle, 70 per cent of the sun is obscured

New Electric Truck Serves as Sprinkler

THIS new electric motor truck recently developed by a British manufacturer has been found especially useful as a sprinkling truck for use in street cleaning.

The batteries, which operate the truck for from 25 to 35 miles without recharging, are carried under the frame and are arranged for easy removal. The electric motor with its countershaft is attached to special brackets on the frame which allow easy and correct chain adjustment. The power is transmitted to the rear wheels by two roller chains, one to each wheel.

The motor controls in the cab provide three forward speeds and two reverses. The battery charge is good for 25 miles.

Snap-on Rubber Heels are Interchangeable

THE life of rubber heels can be doubled, it is claimed, with a newly invented type of snap-on heel that can be used interchangeably on either shoe. When heels become worn out on one side of the shoe, they can be pulled off, interchanged and used again without danger of injuring the ankle. They can be changed by anyone in a few seconds.

Nails with large heads are driven into the heel support so as to fit into holes in the rubber heel. No glue is used and no screws or nails pass through the detachable heel. The latter is readily removed simply by pulling on it.

Clamp Device Holds Fish Tail for Scaling

FOR fishermen who balk at the chore of scaling the big beauties after they land them, Denis E. Bowe, of Waseca, Minn., has invented a wire clamp device that holds the fish head and tail firmly while the scales are being removed.

The fish is placed on a long wire frame, to which is attached a spring clamp that holds the tail. The head is imprisoned in two upward-curving pieces of metal.

Since the tail clamp moves on a swivel-jointed link, the fish can be flopped over from one side to the other without giving it the chance to do the flopping itself.

THE centrifugal force principle used in machines to separate cream from milk now is employed in a new device to determine the amount of ash in a sample of finely ground coal by separating combustible and waste products.

Auto Chassis on Pivots Reduces Road Shocks

A NOVEL automobile chassis which, by means of a pivot arrangement, is said to keep the body of the car riding practically on the level even when the wheels strike the roughest bumps has been devised by Dr. Joao Severiano de Mirando, of Taubate, Brazil.

The chassis includes an inner and an outer frame. The inner frame, which carries the body of the car, is mounted pivotally on the outer frame which in turn is mounted on springs from the front and rear axles. The four pivot points are midway of the front and rear frame bars and midway of the side bars. Thus, whenever an obstruction is encountered, the outer frame tilts with the movement of the wheels, while the inner frame remains level.

How to Save Woodwork from Scorching behind Stove

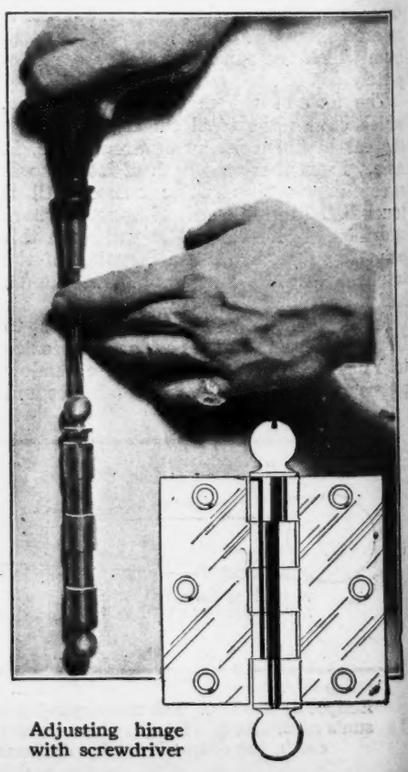
WOODWORK behind a stove or range can be saved from scorching by washing the wood with liquid asbestos paint, which can be mixed at home in this way:

Three parts gumlac, four parts sodium borate, seven parts powdered asbestos, 20 parts water. Heat the water, add the gumlac and borate, and when all have been dissolved stir in the asbestos.

Adjustable Hinge Keeps Doors from Jamming

ANNOYANCE caused by a door which becomes jammed in wet weather and rattles in the wind in dry weather may be eliminated by means of a newly invented adjustable hinge.

By adjusting the hinge door clearances can be changed quickly when changes in weather cause the wood to expand or contract. The head of the pin has a notch for a screw driver, and the pin itself is shaped so that when a turn of the screwdriver twists it around, the two sections of the hinge are brought together or forced apart.



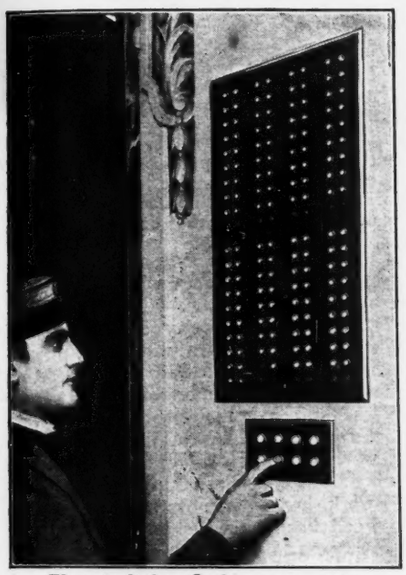
Adjusting hinge with screwdriver

Signal Lights Show Vacant Seats in Theater

BY MEANS of an elaborate system of electric signal lights, the key of which is a "spot board" located in the lobby, the management of a large Chicago theater is able to tell at a glance just how many seats are vacant, and where these seats are located. It is claimed that in 15 seconds a complete check on seat vacancies, 95 per cent accurate, can be obtained.

The signalling system, operated by trained ushers, is said to save much time and confusion in the seating of audiences.

The "spot board" is divided into two sections, one representing the balcony, the other the main floor. Each of the two larger sections is divided into four smaller sections representing tiers, each containing two rows of little electric bulbs, nine bulbs to a row. Each bulb in the left row of each section represents 10 seats progressively from top to bottom.



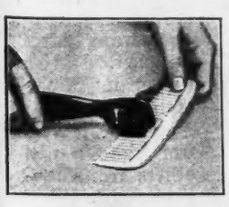
Electric lights flash vacant seats

For example, when the third bulb from the top flashes, it means 30 vacant seats in that tier of the theater. The bulbs in the right hand row represent the digits. Thus, if in addition to the bulb designated above, the seventh bulb from the top on the right row flashes, it means there are 37 seats vacant in that particular section.

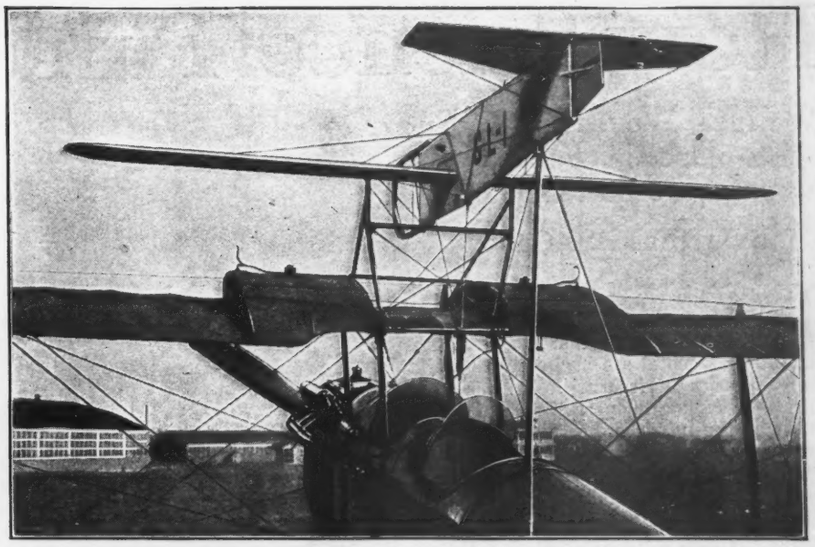
Lights in any one section of the board are flashed by pressing the proper button in a series of buttons below the board.

Sanitary Roller Brush Cleans Combs Quickly

ONE of the newest sanitary devices for the boudoir is a roller brush designed for cleaning combs. As the brush is rolled over the comb, the stiff bristles enter between the teeth, quickly cleaning out all dust and hair.



The roller brush is so constructed that it can be removed from the handle for washing, thus providing an entirely sanitary and easy method of cleaning.



Small Glider Target for Anti-Aircraft Guns

ANTI-AIRCRAFT defense practice is made realistic at McCook Field, Dayton, Ohio, by a motorless target glider that goes through the maneuvers of a real air plane as it glides to the ground after release from the carrying plane.

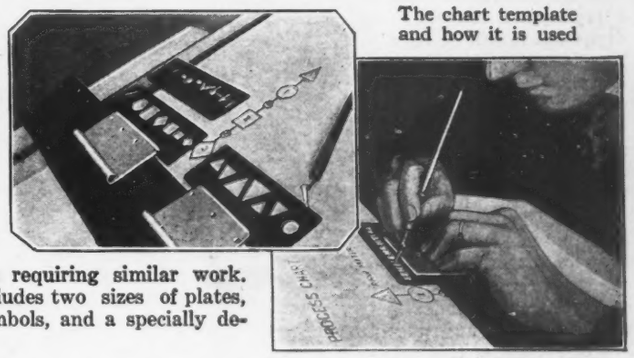
The glider, made of linen, wood, and a piece of metal, has a twelve-foot wing spread. It can be riddled with bullets from defense guns without destruction.

When a wire holding it to supports on top of the airplane is released, the glider, in an upward loop, frees itself. The set of the tail determines the angle of descent, while the rudder determines whether the descent will be straight, spiral, or undulating. A descent from 10,000 feet in the air takes about 30 minutes.

New "Shorthand" Templates for Factory Charts

A SHORTHAND system of industrial efficiency is embodied in a set of templates designed recently by Frank B. Gilbreth, noted "one best way" engineer, for quickly drawing symbols and letters on process charts, production charts and other factory records requiring similar work.

The equipment includes two sizes of plates, each with a set of symbols, and a specially designed drawing pen.



The chart template and how it is used

Eye Exerciser to Correct Faulty Vision

The eye exerciser and its inventor

ON THE theory that the human eyeball is pulled out of shape by the tugging of strong muscles against weaker ones, thus interfering with the focusing of light rays and causing nearsight, farsight and astigmatism, Dr. Nelson Y. Hull, a New York optometrist, has invented a novel machine for exercising eye muscles.

The exerciser consists of a ball on the end of a bent rod which is revolved by means of a small crank. The eyes are exercised by following the motions of the ball.

For near sight the ball first is moved horizontally before the eyes, bringing into play the muscles that move each eye toward or away from the nose. Then the ball is moved perpendicularly. This exercises the muscles that move the eye up or down.

For far sight the oblique muscles are brought into play by operating the ball in circles both left and right.

Astigmatism is corrected by either one or the other of the foregoing methods, or a combination of the two.

Normal eyes can be kept in good condition Doctor Hull claims, by regular exercises that bring all the muscles into play.

How Science Turns the World

Wonder Waves Now Put to Use in Factory, Home and Shop

By Wilfred S. Ogden

JUST as the use of X-rays has revolutionized surgery and dentistry, so now these wonderful rays that can penetrate the toughest metal are beginning to work their miracles in industry. In this new field, their fascinating possibilities, of which until now the public has heard little, are just beginning to be developed by science. They promise, engineers think, to be even more important to mankind than the services of the rays in fighting disease and relieving the pain and torture of surgery.

X-rays have been used successfully already to detect hidden flaws in airplane parts, to inspect metal castings, to determine the quality of the fabric inside automobile tires, to expose fake modern paintings masquerading as "old masters," to help shoe clerks see the bones of customers' feet and thus make correct fittings of shoes—even to disclose irregularities in the centers of golf balls and reveal why some of them fly straighter and farther than others.

This illustration and the one on the opposite page are actual reproductions of a remarkable X-ray movie film, recently exhibited in New York, showing the positions and movements of a young woman's jaw bones while eating an apple

And this list is only a starter. In 25 years the X-Ray machine will have become so indispensible in everyday life, scientists predict, that it will be hard to imagine a world without it.

Consider what the X-ray permits us to do. With it we can see into and through almost anything. Sealed chests of wood become as transparent as glass. Even steel safes, locked and bolted can be penetrated. The rays of our present machines will penetrate three inches of iron. And scientists are promising rays of five or six times this penetrating power.

X-rays now are aiding shoe clerks to make correct fittings, by revealing the bone structure and movements of the customers' feet

There is nothing very mysterious about the nature of these rays. They differ from ordinary light rays merely as one color of light differs from another color; that is, they differ in wave length. Radio fans at once will recognize this expression "wave length." Broadcasting stations operate usually at a wave length of 365 meters, while ordinary light consists of waves less than a millionth of a meter long. The X-rays are a still shorter kind of waves. Most of them are less than a hundred millionth of a meter long.

Up-to-date clothing stores soon may be equipped with X-ray apparatus, by which customers may examine goods to determine quality or to discover any imperfections

It is because the waves of the X-rays are so short that they go through material so easily. They slip between the atoms of things and get through where the waves of ordinary light are stopped. Some things, like bones or metals, stop the X-rays a little more than other things do and so they cast shadows. This is why doctors can look through our flesh with X-rays and can see our bones.

It is this penetrating ability of X-rays that makes the rays so useful in industry. A striking instance of this usefulness was the inspection of airplane parts in England during the war. When submarines were active and the supply of the best kinds of wood was uncertain, it was necessary to make some of the wooden parts out of small pieces of ordinary wood fitted and glued together.

The way these pieces were joined and fastened was extremely important. A bit of weak glue inside some little strut might mean a disastrous collapse in the air. But real inspection seemed impossible, for the places where important faults might exist were hidden from view. Finally scientists solved the problem by building an X-ray apparatus with which they could look into the inside of each built-up airplane part and tell whether it held some little imperfection which might prove dangerous.

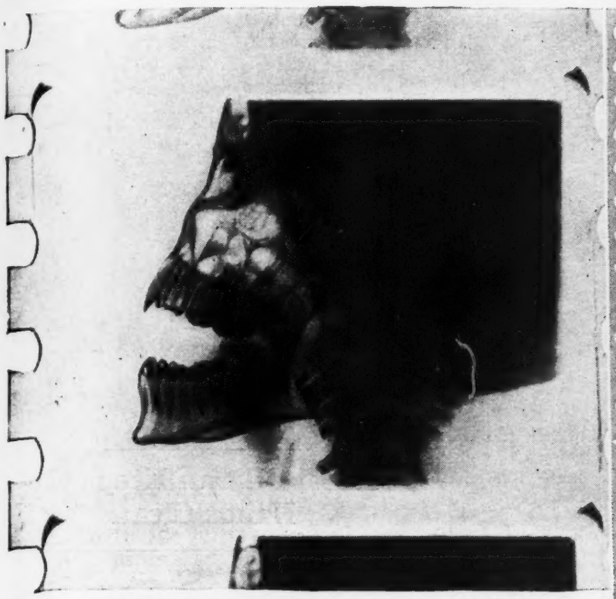
This "internal inspection" of wooden articles by X-ray has been applied, since the war, to many other articles. Hidden joints inside high-class furniture and cabinet work, invisible knots and flaws inside the wood itself, can be determined easily by X-ray examination.

The same kind of inspection has been applied to metal articles. Cracks in castings, bad welds and weak places which do not show on the surface of the metal, are perfectly clear to the searching rays. How much would you give to *know* that that welded part on your automobile is really solid and perfect, that it contains no flaw to break down some day when you are 20 miles from a machine shop? A well-known mechanical engineer said recently that in ten years a metallurgical X-ray machine will be as vital a part of the equipment in an automobile repair shop, a foundry, or machine shop as it is now in a dentist's office.

The list of other industrial applications is a long one. One of the most interesting is the examination of boxed and sealed apparatus. Suppose, you want to know how your radio set is built and you don't want to take it apart. Have a doctor make several X-ray photographs of it; one from above and others from other points of view. The plates will show the position of each wire, plate and screw

Eventually auto repair shops will have X-ray machines to detect flaws in metal welds or castings of motor cars

Inside-Out by X-Rays



How the X-ray movies reveal the jaws and their movements during the apple eating process. The bones stop the penetrating rays more than do the flesh and muscles, thus casting shadows on the photographic negative

In the jewelry shop, X-ray examination reveals whether a jewel is genuine or false, and whether the setting is gold or imitation

and by comparing negatives you will be able to make a complete diagram of the entire set without taking it apart.

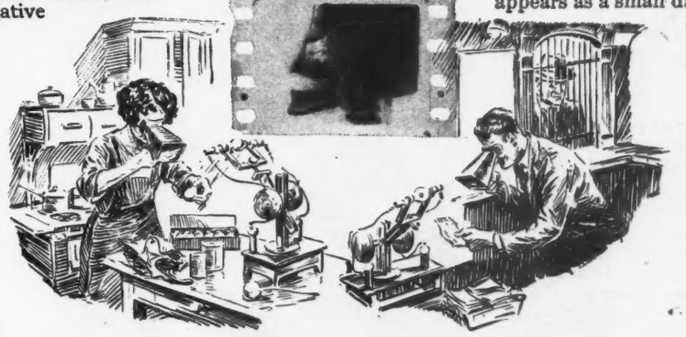
Some months ago there arrived from Germany a new kind of mechanical doll. A secret mechanism inside enabled it to walk, sit down or stand up, and to do other unusual things. The importer in possession of the sample doll would not allow it to be opened.

But one of his competitors borrowed the doll. He had promised not to open it. But he made some X-ray photographs of it. Now he is manufacturing these dolls himself.

X-rays have been used already to expose many kinds of trickery. Concealed wires in the apparatus of fake spiritualists are plain to the revealing rays. Fake antique furniture; false Egyptian mummies; modern imitations of paintings by old masters; all these yield up their nefarious secrets instantly.

Paste jewels are distinguishable at once from the genuine stones. A piece of jewelry can be examined; the setting identified as gold, platinum or as imitation, the stones distinguished one by one as genuine or false—all without dismounting. In a few years an X-ray equipment probably will be as necessary in an up-to-date jeweller shop as balances or testing acids are today.

The professional detective, too, will find X-rays useful in his business. Consider the detection of infernal machines, for example. Two or three X-ray plates will tell an investigator just what is in a suspicious looking box. If it is a bomb the X-ray will show him how to get it apart and render it harmless. Immediate detection of false bottoms in trunks is child's play with the X-ray. When the Government provides its customs inspectors with X-ray machines the gems which smugglers try to hide in the linings of clothes or in hollow-handled hair-brushes might as well be worn openly.



By passing eggs through X-rays and observing their shadows the housewife can tell whether the eggs from the store are fresh

The bank teller determines at a glance whether a check has been altered, by X-ray examination of the ink and its quality

The X-rays give us one of the easiest ways to detect the alteration of checks and other documents. It is seldom that such an alteration is made with exactly the same ink used on the original. Inks even of the same color, differ in the way they affect the rays. In most cases all that is necessary to detect an alteration is to place the suspected document for a moment under the X-rays and make a photograph of it. The new ink used in the alteration will stand out clearly as different from the old.

In the smoke shop, the customer may determine the texture and composition of cigars by X-ray

The industrial detective will find X-rays just as useful. The adulteration of foods by sawdust, sand, or clay; the adding of too much filler to paper; the presence of grit in lubricating oil, all will be revealed.

Another use of the rays comes home to every cook and housewife. X-rays constitute the only sure way to tell good eggs from bad. Pass each egg in turn through the X-rays and let its shadow fall on a chemical screen. You will see exactly what is inside each egg. The ones containing hopeful chicks may be rejected.

One of the most curious of the possible uses of the rays is in testing oysters for pearls. On an X-ray plate of the living oyster each pearl that is inside the oyster appears as a small dark spot. The examiner can tell at a glance which oysters contain pearls and just where the pearls are located so that they can be removed, without killing the pearl producing oysters.

Fantastic? No more so than some of the things the X-rays already have made possible.

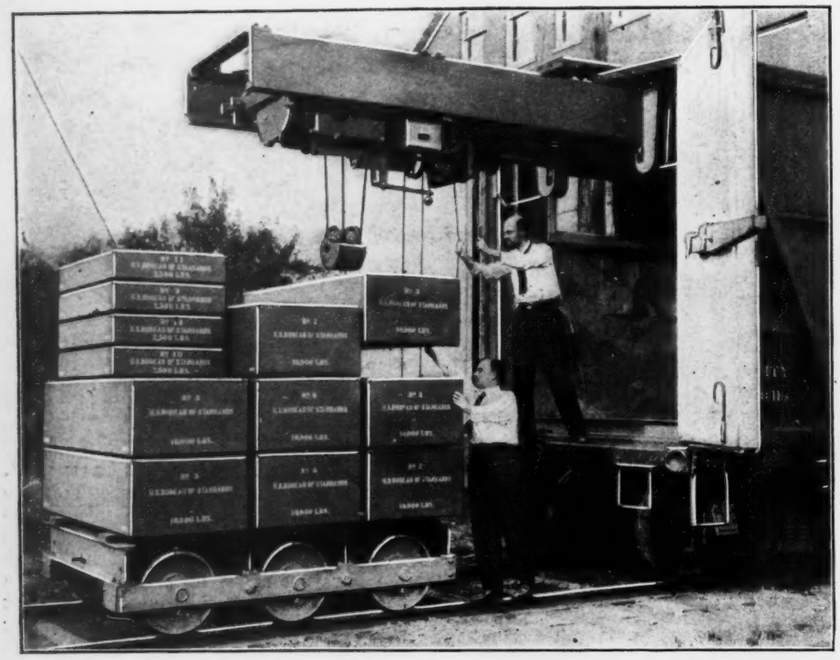
A few months ago scientists used the rays to learn valuable facts about the history of a fossil tooth found in Nebraska, believed to have been the tooth of an ape-like creature that lived on the American continent many millions of years ago.

The list of valuable applications of the X-rays might be extended indefinitely. One of the most far-reaching possibilities lies in their uses in motion pictures. Even now X-ray movies have been developed with such success as to assure their usefulness to science in studying the structure and movements of the bones while the body is in motion. In the classroom, in the gymnasium, on the football or baseball field, and even on the stage, movies of this kind promise to become valuable aids in correcting faults in posture and movement.

Many actors, for instance, experience difficulty in learning to walk and stand gracefully on the stage. Here the bones of the body play as important a part as the muscles. X-ray motion pictures of walking skeletons of actors and actresses may solve the difficulties of posture quickly and easily.

Is it too fantastic to predict that some day the stage manager will pick his chorus with an X-ray machine?

HOW migratory birds and their habits can be studied at home will be described in a fascinating article on the banding of birds, next month.



How Uncle Sam Tests Master Scales

TO TEST with scientific accuracy the master scales used by railroads, Uncle Sam now employs carefully standardized weights which are shipped about the country on flat cars. Since each railroad tests all the scales on its line with its own master scale, this new method of government weight tests assures national uniformity of weight measurements. The photograph shows a master scale being tested.

New Optical Instrument to Make Glasses Fit

TO DETERMINE the exact distance between the eye centers in measuring the face for glasses, a German optician has invented a device which, he claims, insures that the axes of the glass lenses will be in perfect line with the eyes. The examiner observes the two eyes through two connected tubes. Two pointers are moved across the field of vision until they bisect the eyeball. Measurements are then taken.

Measuring a patient's eyes with the instrument shown at the left

Army Develops Talking Gas Mask

Two types of the diaphragm gas mask—with self contained canister (above) and with canister tube (at right)

A NEW gas mask recently invented by an officer of the Chemical Warfare Service, U. S. Army, is said to overcome the difficulty of talking while the mask is in place.

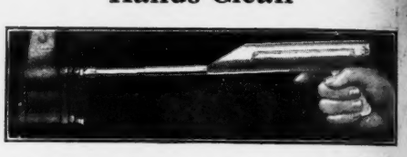
A diaphragm of tracing cloth which cannot be penetrated by gases is held in place in front of the mouth by an aluminum disk. The vibration of the disk caused by the speaker's voice transmits the sound almost as clearly as though no mask were worn.

In addition to this advantage, the mask is supplied with chemicals which makes it valuable as a resistant to other than war gases. Wearing this mask, a fireman need not fear deadly carbon monoxide, ammonia and other fumes.

Many-Hook Device Saves Space in Closets

COMBINING many hooks in one, the ingenious metal device shown at the right has been designed to save space in small closets. Each hook carries a clothes hanger. In addition, it will make an ideal rack for knives and brushes in the kitchen. It also can be utilized in the garage as a rack for tools.

Pistol Oil Can Keeps the Hands Clean

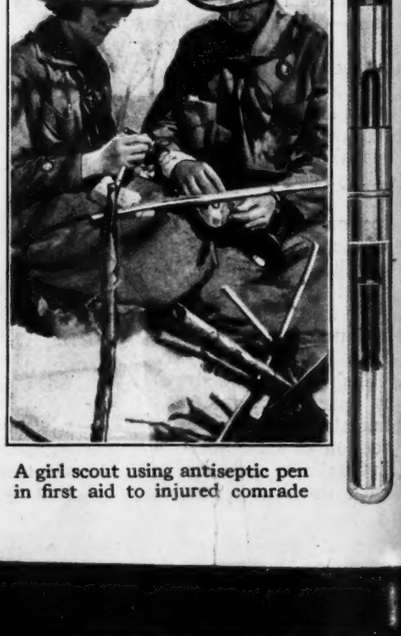


ANYONE who has tried to oil the family car or the lawn mower without getting daubed with oil will appreciate a new oil can that works like a pistol.

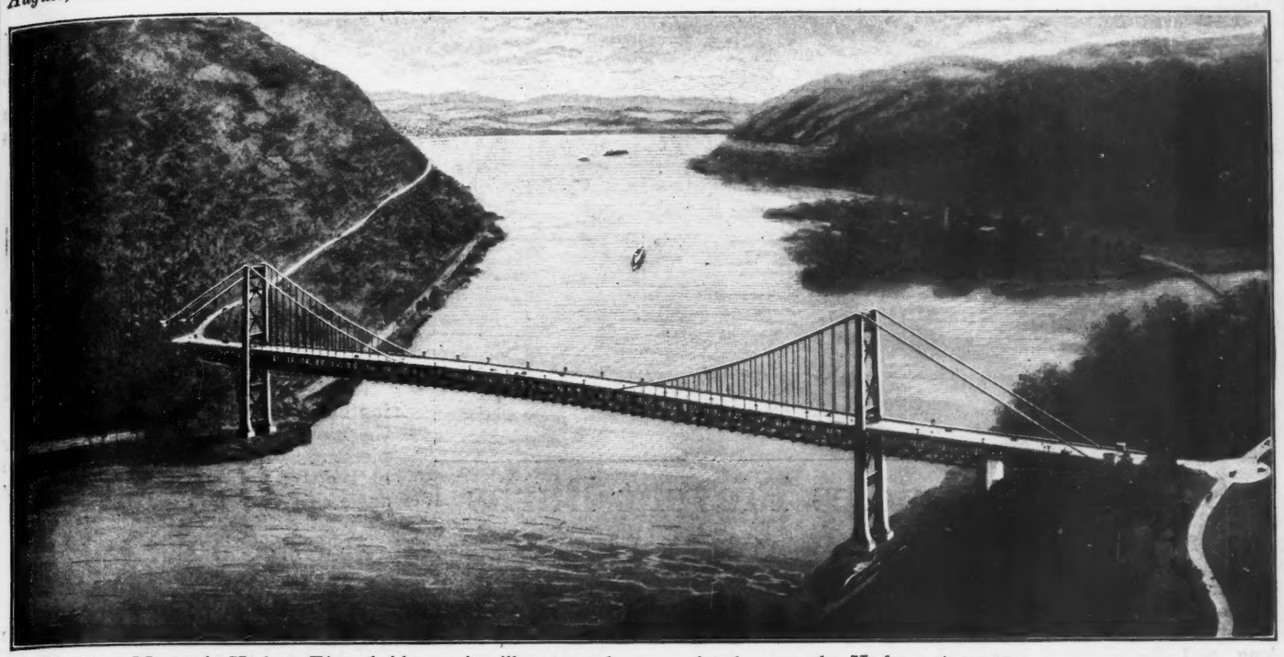
The can is grasped in the hand like a revolver, the nozzle is placed against the oil cup or nipple, and a push sends the oil into the machine.

New Iodine Antiseptic Pen Useful for First Aid

AN IODINE antiseptic pen is one of the valuable new additions to first aid equipment. The pen consists of two glass tubes, a rubber stopper and a distributing brush. Iodine is placed in the bottom tube. The rubber stopper, into which the pen is fitted, is then inserted. The iodine flows from the pen through a wick or brush, which may be cut off after being used leaving a fresh end.



A girl scout using antiseptic pen in first aid to injured comrade



The Bear Mountain-Hudson River bridge as it will appear when completed across the Hudson at a narrow point near Peekskill, N. Y. It is predicted 600,000 automobiles will pass over the bridge annually

World's Longest Suspension Bridge to Span the Hudson

WORK in the construction of America's greatest suspension bridge, the center span of which will be the longest in the world, was begun recently on both sides of the Hudson River, three miles from Peekskill, N. Y.

The new bridge, which will be completed about April, 1925, is to be known as the Bear Mountain-Hudson River Bridge, taking its name from the Bear Mountain reservation, a section of the Palisades Interstate Park system which will be its westerly terminus.

To Link Important Highways

Need for a bridge linking the highways on the east and west banks of the Hudson long has been felt. The site of the bridge now under construction was selected because it is the narrowest part of the river. In addition, it is within easy distance of New York and other cities that supply heavy motor traffic for the State highways. The rock formations at the site are suitable for the support of the tremendous weight of the structure and of advantageous elevations for the support of the approaching spans.

The new structure will have a total length of 2252 feet, including approaches. The center span will be 1632 feet long,—32 feet longer than that of the Williamsburg Bridge across the East River in New York City, which now is the longest in the world. The clear height above the river will be 155 feet, about 20 feet higher than any of the bridges connecting Manhattan with Brooklyn. The 350-foot steel towers likewise will rise high above those of the great East River bridges.

On the east side of the river will be constructed an approach road of concrete to connect the bridge with the nearest highway. The west approach highway will be on the axis of the bridge and will connect with State Highway Route No. 3 at a point about 1000 feet from the bridge.

More than 7000 wires will make up the 17-inch cables on which the roadway will be supported and 12,552 tons of steel will be used in construction. There will be a 38-foot roadway in the center, with side-walks five feet in width at each side.

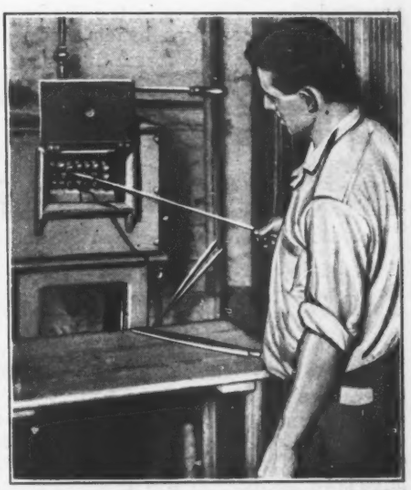
The location of the bridge is about 45 miles from Times Square, New York City. Conservative estimates are that at least 600,000 automobiles will pass over it during the course of one year.

Postman Invents Bicycle Holder for His Pack

FROM an iron bar, a Florida letter carrier has devised a convenient rack to support his pack on his bicycle.

The rack is made of a five-foot strip of 3/16-inch flat iron bar bent into a flat bottomed V. Three inches from the bottom, which rests on the fork of the bicycle, each arm of the V is given a quarter turn so it will rest flat against the handle bars, where it is fastened by a shackle. The upper ends of the V are bent to form hooks. The pack, suspended from these hooks, rests on a quarter-inch shelf bar fitted in holes in the sides of the V. The same carrier may be attached to any bicycle and will prove useful to summer campers.

The postman and his pack carrier



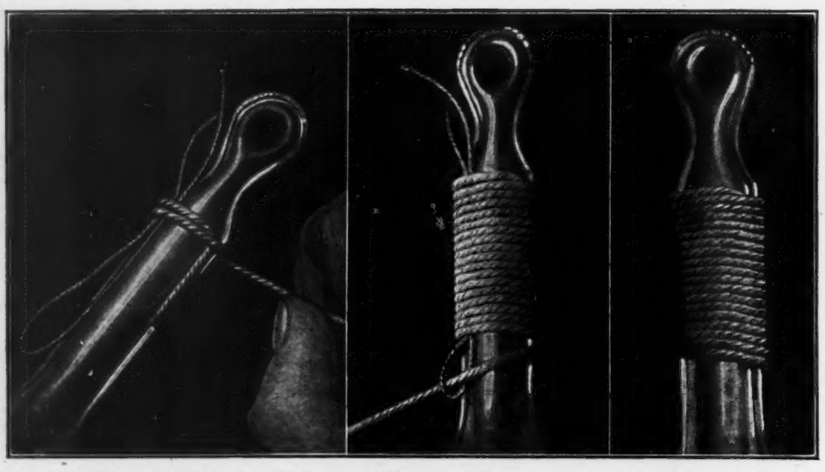
Simple Magnet Tool for Tempering Steel

A SIMPLE magnet, recently invented by R. Rickenbach, of Pittsburgh, Pa., will determine accurately the proper temperature at which metals harden.

When steel reaches the temperature of hardening a change takes place in the magnetic properties of the metal. Realizing this condition, the inventor has mounted a permanent magnet on a handle. This instrument replaces the inaccurate color method in tempering steels.

The magnet is balanced at the end of the handle. When held near ordinary steel, the magnet is attracted and dips down. When the critical hardening point is reached, however, the magnet fails to dip, and the operator removes the metal from the heater at once.

Dr. James J. Walsh, leading New York physician, has prepared a remarkable article on auto-suggestion, the new science of the mind, for the September issue.



String Pot Handles Prevent Burns

TO PREVENT burnt fingers and eliminate the use of bothersome pot holders, try this on some of the pots in your kitchen:

Obtain some thick string about three feet long, and also about 8 inches of strong twine. Loop the twine and place it down one side of the handle, then commence wrapping the thick string around the handle and twine. When the wrapping is complete, push the loose end of the thick string through the loop of the twine. Now pull the unlooped ends of the twine. This will pull the loose ends of the string under the wrapping and hold them securely.

There will be less burnt fingers and no need of pot holders when kitchen equipment has been treated in this manner.

Pocket Tooth Brush Folds Into Case

DESIGNED especially for travelers, a new folding pocket tooth brush is so arranged that when not in use the brush part, including a short handle, may be detached and enclosed in a metal container. This container protects the clothing from dampness remaining in the brush and keeps the brush itself in a sanitary condition.

The toothbrush ready for use. Container forms the handle

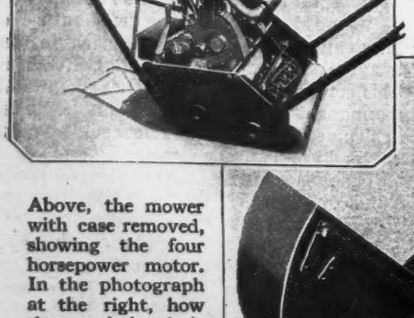
The container is made of a special metal that will not rust or corrode. The brush is detachable and may be replaced at any time by a "refill" of the same make.

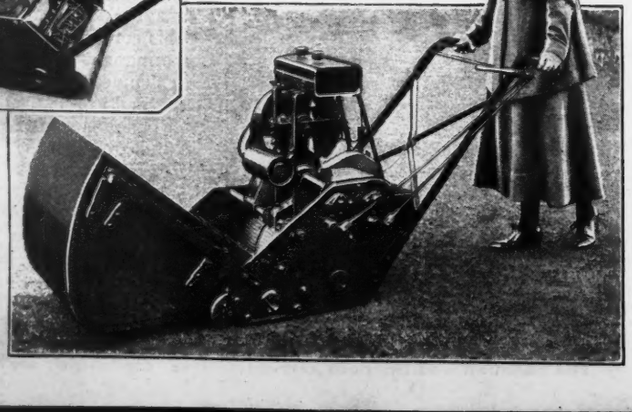
New Power Mower for Large Lawns

A FOUR horsepower motorized lawn mower and roller that can be operated easily by a woman has been perfected by an English manufacturer. The machine can be driven over soft ground, and does away with the use of horses for park and large lawn mowing. It will mow two and a half acres on a gallon and a quarter of gasoline, the manufacturers claim, in half the time required by a horse drawn mower of the same width requiring a team and two men.

A four-cylinder gasoline engine, cooled by a fan, supplies the power. The main spindle runs on ball bearings and has a differential gear so that it can be turned around on its own ground. Thus the machine can cut in corners and small spaces.

The grass as it is cut is caught in a removable steel hood, which serves as cover for machine when not in use.





Above, the mower with case removed, showing the four horsepower motor. In the photograph at the right, how the steel hood is used as a container to catch the grass after it is cut

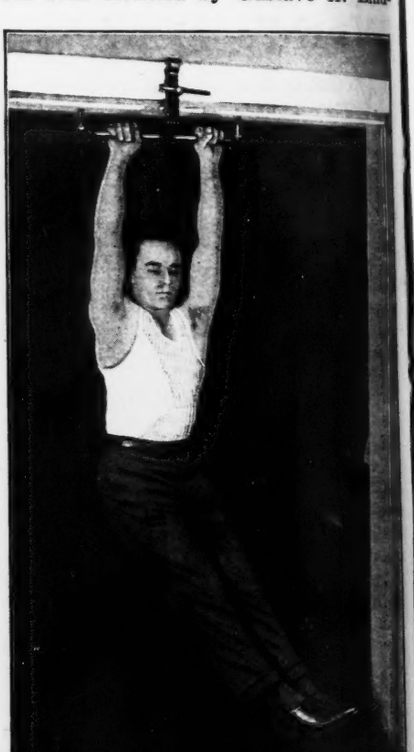
Folding Pocket Music Rack Fits Back of Chair

A NEW music rack that folds to fit in the pocket is a convenience for musicians who often are asked to play where ordinary stands are not available. The holder is made of brass wire with rubber covered hooks that will slip over a chair-back.

A tubular sliding bar connects the two main supports and small triangular pieces of wood sliding up and down on the back of the rack serve to adjust it at any angle that may be desired.

Horizontal Bar Exerciser Hangs in Doorway

A HORIZONTAL bar exercising device that can be attached to the frame of a doorway without marring the woodwork has been invented by Gustave A. Lindstrom and Dr. George Senn, of Green Bay, Wis. It may be used for swinging exercises, or a rope swing for children's use may be attached.



Exercising on the doorway horizontal bar

Felt lined metal straps provided with a series of openings grip the upper edges of the trim over the head of the door. Screwed to these straps through the openings is a yoke member, in the center of which is mounted a horizontal bar. Brass rods at each end of the bar brace it against the under side of the door frame head so as to prevent any side movement.

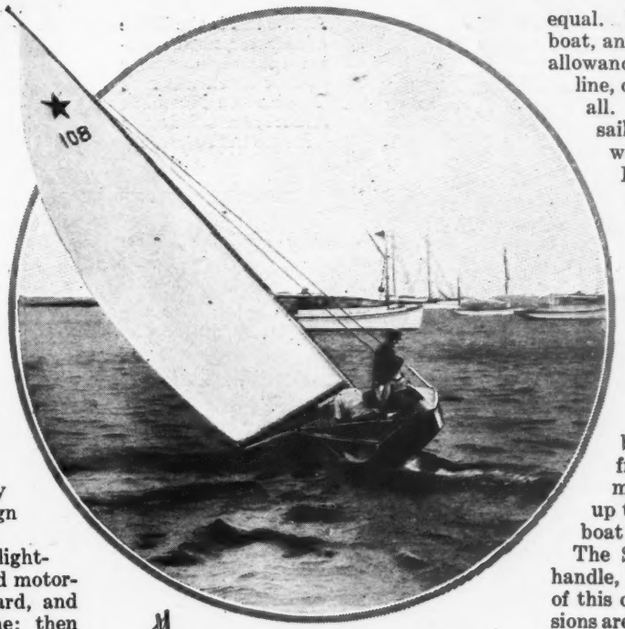
The Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue.

Where Skippers Match Skill

Small Sailboat Racing Comes Back as Popular Summer Sport; Sloops of Star Class Test Scientific Seamanship

By George A. Corry

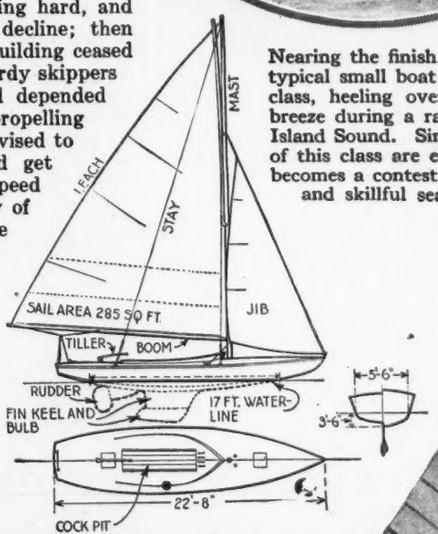
President of the Star Racing Association. Mr. Corry is known as "the father of the Star sailboat." By his skill and seamanship he has won 10 sailing championships and more than 350 prizes and trophies



Nearing the finish. Here is a typical small boat of the Star class, heeling over in a stiff breeze during a race on Long Island Sound. Since all boats of this class are equal, a race becomes a contest of scientific and skillful seamanship

SMALL boat sailing and racing this season is enjoying a boom such as the sport hasn't known for a quarter of a century. This rejuvenation and return to popularity of a pastime that seemed doomed to extinction with the advent of the automobile and the motorboat, has been brought about almost entirely by the development of the one design sailboat, known as the Star class.

The introduction of the cheap, lightweight gas engine in motor-cars and motorboats hit small sailboat sailing hard, and the sport went into a steady decline; then the war came and sailboat building ceased for three years. The few hardy skippers who stuck to the helm and depended upon natural forces for propelling power in those days were advised to "put a 'kicker' in her and get somewhere." Nothing but speed seemed to interest this army of "scorchers" and new engine drivers who only lately had tired of the bicycle fad. But even in those days when small boat sailing was at its lowest ebb there remained a small group of yachtsmen who still were faithful to the call of the ships, and who were held steadfast by the lure of the sea. In 1910 I was able to interest a few members of the American Yacht Club, of Milton Point, Rye, New York, in a project to build a number of small sailboats of the same design with the object of racing among themselves. The plan succeeded far beyond my expectations. The popularity of the boats grew so rapidly that in a short time the Manhasset Bay Yacht Club, the Larchmont Yacht Club, and many other clubs on the Long Island Sound were sailing fleets of them. Then the boats appeared along the Atlantic Coast from Massachusetts to the Gulf ports, and on the Great Lakes at Toledo, Rochester, Cleveland and Toronto. Now there are fleets of them on the Pacific Coast at Los Angeles, San Francisco and Seattle. They are also being sailed in South America, and in far off Australia and New Zealand.



The design and dimensions of the hull and rigging of the Star class boat. Note the jib-headed or leg o' mutton mainsail characteristic of the "Marconi" rigging of boats of this class

What is the reason for this almost world-wide popularity?

The first great advantage of the Star is that in design all the boats are equal. You race on even terms, boat for boat, and man for man. There are no time allowances to be figured. The beam, water line, overall and sail area are identical for all. Only one inequality is possible in sailing the Star boat; that is the man with the "stick"—the skipper.

It is the introduction of this personal element that makes this sport so attractive to the American who dearly loves a contest in which skill, courage, science and wits are matched. While it is good fun to knock about in a small sailboat without any particular object in view except weathering rough seas or making egg-shell landings, it is thrilling to look across your bows at another boat only a few feet of water away from you racing to beat you to the mark. All things are equal, and it is up to you to beat the man in the other boat by your seamanship.

The Star is not only fast and easy to handle, but it is a safe boat. Not one boat of this class ever has capsized. Its dimensions are: length, 22 feet, 8 inches; water line, 17 feet; beam, 5 feet, 6 inches; draught, 3 feet, 6 inches; sail area 285 square feet. It is built with a cast-iron fin and bulb, weighing 860 lbs.

Originally a Star boat cost $260, but mounting prices for labor and materials have increased to such an extent that its cost to-day is $850. The upkeep is very small, and with good care it will last a life time. The "Taurus," the No. 1 boat of this class, built 13 years ago, and sailed by W. L. Inslee, won the Championship of America in 1922.

Last year at the Larchmont Regatta 26 Stars were entered in a race—the largest number of one design boats that ever has competed in a single race. This year the Larchmont club expects to have at least 40 Star entries.

At the International Championship races of the Star class scheduled for Long Island Sound, on August 28, 29 and 30, fleets from the United States and Canada are entered, and it is expected that entries will be received from England, Norway, China, Turkey, New Zealand, Barbados, and Australia.

In choosing a small sailboat there are three important points to consider: the depth of the water, where it is to be sailed, the smoothness of the water, and the cost. If the bay or river where you plan to sail your boat is shallow, then by all means don't buy a keel boat, but get a catboat with centerboard. Hundreds of these catrigged boats are sailed on the shallow Detroit River and Lake St. Clair in Michigan. Several classes of catboats have been developed and they can be bought for $200 to $400, according to size. If you

The "Taurus," first Star boat ever built, and champion of them all. Although laid down in 1910, this little sloop won the American championship of its class in 1922

are planning to sail in rough, open waters, then you need a decked-in boat with cockpit. A sloop rigged keel boat is best under these conditions. The "Marconi" Rig is used on most racing sloops now. This rig makes the small sailboat at least a minute faster per mile when sailing on the wind. The "Marconi" does away with the gaff. It was invented by Nicholson, the English boatbuilder, who designed the last "Shamrock" for Sir Thomas Lipton.

Most skippers put their boats into commission themselves. It is good fun in the early spring to scrape off the old paint, sandpaper the deck and underbody, putty the seams and finally to put on a bright coat of new paint. This part of the game is a real pleasure because while you work your mind wanders in the "Land of Anticipation" and you are exhilarated by the thought of the good times to come.

Catboat for Beginners

The catboat with centerboard is the best boat for the beginner to learn in. It is easier to manage than the sloop rigged craft, and at the same time it requires more delicate handling. In a catboat you get the "feel" of the boat under you, and learn just what she will stand. A sloop with weighted keel, on the other hand, will heel over and lug her sails until the wind blows over them, yet still be in no danger of capsizing. A catboat with centerboard only requires skilful handling to keep her on her feet if caught in a blow.

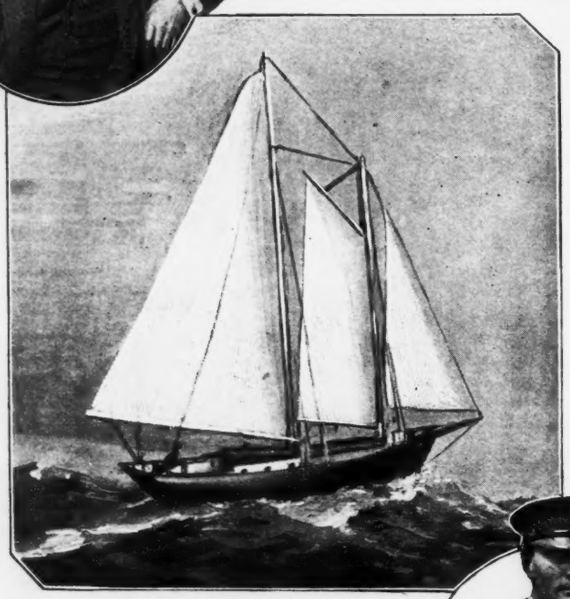
But the best advice for beginner and experienced skipper alike is this: Buy the kind of boat that is being sailed in your home waters. In this way you get competition. One season of keen racing will teach the landlubber more of the art of sailing a small boat than he'll learn in 10 years knocking about by himself.

In Rochester and Toronto the 12 foot dinghy is popular; at Marblehead it is the 12 foot catboat class. These boats can be purchased for from $150 to $300. In Massachusetts Bay, Oyster Bay, and Great South Bay, Long Island, catboats with centerboards are found in great profusion, and in all sizes from 12 to 25 feet. The prices range from $150 to $700.

Small sailboat racing and sailing have come back to stay.

Sailboats to Race Across Atlantic

At the left is the Duke of Leinster, noted British sportsman, whose 40-foot ketch will race Commodore Nutting's American schooner across the Atlantic



At the right is William Washburn Nutting of New York, ex-Commodore of the Cruising Club of America, and challenger in the transatlantic small boat race. The rig of his schooner "Harpoon" is shown above. Note the jib-headed mainsail, resembling the Marconi type rig used in Star class boats. The object of the contest will be to test the relative merits of typically American and British rigs

TWO 40-foot boats, identical as to hull and of the same sail area, but rigged respectively as an American schooner and a British ketch, will sail soon from New York for Cowes, Isle of Wight, in what is probably the most interesting international race ever arranged. The object of this trans-Atlantic contest is to test for the first time the relative merits of typically American and typically British rigs for pleasure craft.

The contesting skippers will be William Washburn Nutting, of New York, ex-Commodore of the Cruising Club of America, and the Duke of Leinster, noted British sportsman. Mr. Nutting will be remembered for his feat of sailing his 45-foot, ketch-rigged yacht "Typhoon" from Nova Scotia to Cowes, England, and back to New York via Spain and the Azores in 1920.

The challenge for the race was issued by Mr. Nutting last summer. Each boat will be 40 feet overall, and have 32 feet, 6 inches waterline length, 11 feet, 6 inches beam and a draft of 7 feet. The American schooner is to have a jib-headed or leg o' mutton mainsail, while both the mainsail and mizzen of the Duke of Leinster's ketch are to be of this type; that is, without the gaff in the head of the sail.

Each boat will have an auxiliary motor, to be used during calm weather. The American boat has a 15 horsepower motor and the British motor is rated at 20 horsepower.

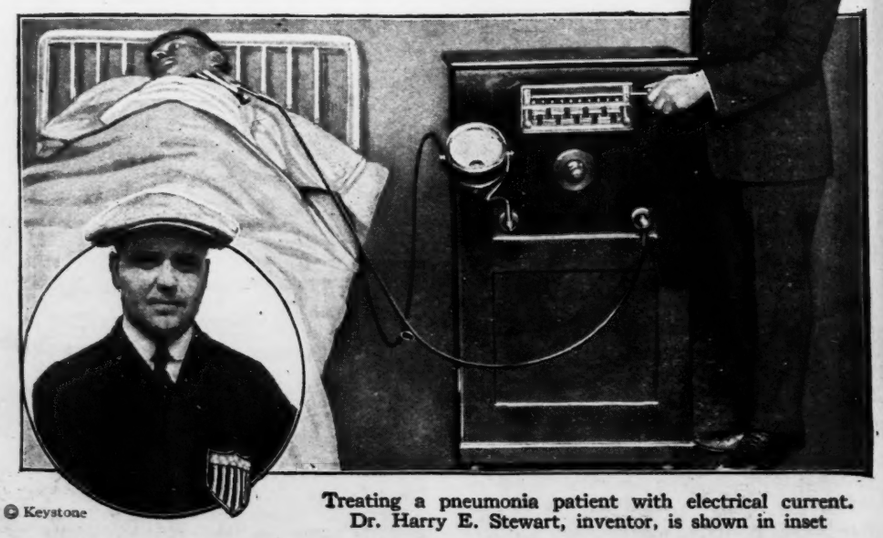
Electric Current Used in Pneumonia Treatment

REMARKABLE success in the treatment of pneumonia by the use of electric current was reported recently by physicians on the staff of St. Mary's Hospital, Hoboken, where the new method perfected by Dr. Harry E. Stewart, Yale University athletic coach, was tested.

The method consists of the application of plates to the chest and back of the patient. and passing high frequency alternating current through the lungs. This increases the temperature within the lungs, it is claimed, tending to break up congestion. More than 30 sufferers in the last stages of pneumonia are said to have been started on the road to recovery in this way.

Medical men have called the new treatment a "super-mustard plaster." It is intended not as a substitute for usual medical treatment of the disease, but to supplement other agencies. The patient lies on operating table. Metal plates are strapped to his chest and back and connected by wires with a large cabinet with dial adjustments. When the switches are thrown on, the patient feels no shock; only a glow of warmth permeating his chest. This treatment is repeated twice each day.

The heat generated by the powerful current through the diseased lungs literally "electrocutes" the pneumonia germs, and recreates blood circulation. Danger of direct current application is avoided by passing it through a closed core transformer.

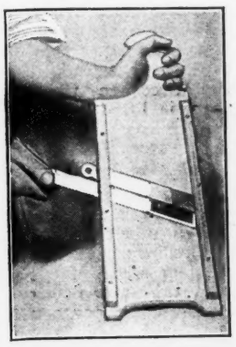


© Keystone

Treating a pneumonia patient with electrical current. Dr. Harry E. Stewart, inventor, is shown in inset

New Type of Shredder Has Removable Knives

IN A new type of shredder for the housewife's kitchen, the knife blades can be removed readily for resharpening. In the usual type of slicer the blades are fixed and the instrument, once it becomes dull, remains so because of the difficulty in removing the knives. The handle of this shredder is well shaped and will not tire the holder's hand.



King Arthur's Candle Clock Comes into Style

AN OLD time novelty that is coming into vogue again is the candle clock. Rings are painted on the candle at regular hour or half hour intervals. Each time the flame reaches a ring the specified time has passed.

The candle clock was invented by King Arthur and the candles are still being manufactured in England.

Bathing Cap Protects Straw Hat from Rain

AN ORDINARY rubber bathing cap, when stretched over the crown and brim of a man's straw hat, serves as an excellent protector against rain.

Above: Covering the pineapple plants with strips of brown paper. At the right: A pineapple plantation with covers removed

Pineapples Flourish under Paper

THE yield of pineapples in the Hawaiian Islands has been increased 50 per cent by forcing the plants to grow through broad strips of brown paper that completely cover the soil around the plants.

Usually when pineapples are planted in the loose soil, the weeds immediately attempt to choke them. The paper serves to smother the undesirable weeds, thereby leaving all the nutriment of the soil for the crop. In addition, the paper covering prevents the sun from baking the surface after it has been moistened by the rain, and thus serves to keep the ground soft and moist.

The paper is obtained from the waste fibers of the sugar cane, a material known as mulch, once considered of no value. Seventy-five thousand rolls of this paper are used each year at a cost of $200,000 to cover the 3500 acres of pineapple plantations in the islands.

A GIANT steam turbine generator being manufactured by the General Electric Co. will supply energy equal to muscle work of 5,400,000 men in three eight hour shifts.

Lift Scaffold Simplifies Painting

A NEW aero lift scaffold for painters and builders, designed to eliminate the necessity of climbing ladders and carrying heavy planks, may be erected or dismantled in a few minutes.

The upright standards are 3⅜ inches square and hollow, and weigh only 1½ pounds to the foot as against the 2½ pounds of the average sturdy ladder. They are built in 2½, 5, 10, 15 and 20-foot sections which can be joined together by inserting a filler block, thus giving any desired height.

The standards are attached to the roof or cornice of a building by an anchor device operated from the ground by means of a ¼-inch line.

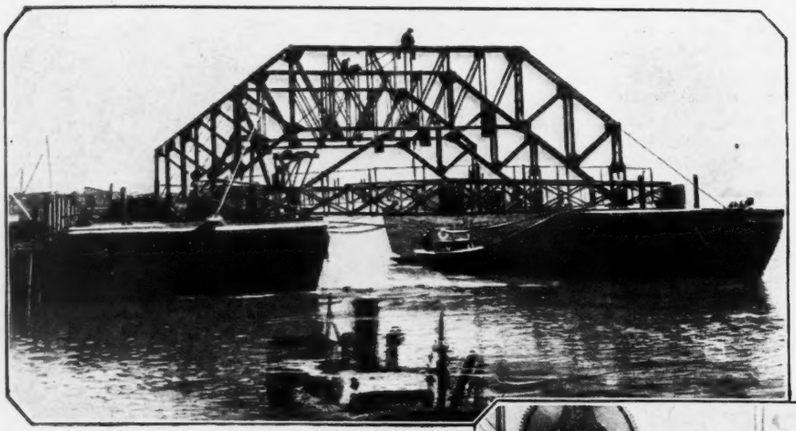
The platform plank is raised by means of a studded shaft turned by cranks, the studs engaging in circular depressions in the standard.

The new scaffold thus takes the place of ladders and jacks, and is said to assure greater safety to workmen.

Hoisting the lift scaffold. Insert at left shows anchoring device. Below, studded shaft and lift cranks for raising platform

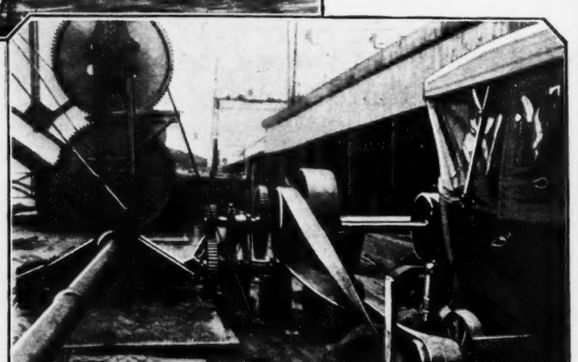
Auto Power Raises Wrecked Ship

PLEASURE automobiles are being put to work, thanks to the ingenuity of engineers who recently have harnessed the automotive power plants to various kinds of machinery. One of the most interesting developments along this line is a new method of raising sunken ships, invented by Charles Mitchell of New York City, and now being tested at Bridgeport, Conn., where the Calvin Tompkins, a 300-foot freight steamer, sank two years ago.



At left: the pontoons, spanned by three trussed arches, floating in position above the wrecked steamer. Lowered steel claws grip the wreckage which then is lifted to the surface by power from an automobile

Below: a belt running on a pulley attached to the rear wheel of the auto drives a power shaft on the pontoon



The apparatus consists of a so-called catamaran hydro-crane, the lifting power of which is supplied by an automobile anchored on the pontoon deck and driven at high speed.

Two pontoons spanned by three trussed arches of steel and held apart by bridges fore and aft, are towed to a position immediately above the wreck. A belt running over a pulley attached to the rear wheel of the auto drives a power shaft on the pontoon. Power is taken off this shaft and used to raise steel claws that grip sections of steel or wooden wreckage from the sunken vessel.

The wreckage then is raised out of the water up to a truss that spans the gap between the two pontoons. By means of sleeved gearing the main shaft is controlled easily in its movement, the cable being wound upon drums below decks as the wreckage is lifted.

It is claimed that the new auto-power apparatus, easily attached to any car, has a lifting power of 750 tons, as compared with the maximum of 250 tons claimed for the largest hydro-crane used by wrecking companies.

New Binocular Magnifying Glass Fits Head

A BINOCULAR magnifying glass, which attaches to a bandeau fastened around the head, has been invented by Dr. J. Molinie of France to take the place of the reflectors with holes in the centers now used by physicians.

The instrument leaves both hands of the user free. It is equipped with a reflector that throws a beam of light on the surface under observation while the glass magnifies it from six to 10 times, according to the distance from the object.

Two eyepieces at the rear can be adjusted to the eyes of the observer. A single telescopic tube in front receives rays from the object being examined. These rays are split by prisms so that each eye views the same image. Screws at the end of the box are used to adjust lenses and prisms, after which the hands are left free.

How binocular magnifying glass is attached to the head, leaving hands free

Replacing Rotted Stumps of Telegraph Poles

A NOVEL method of replacing the rotted portions of telegraph poles without interrupting the wire service recently has been adopted in Europe.

A tripod is constructed to hold the upper portion of the pole in place while the stump is sawed off near the ground. The rotted stump is then removed and a new one is substituted.

The two parts then are connected by means of bolts or braces and the job is completed without taking down the entire pole and thus causing a delay in the service.

GOVERNMENT agricultural experts are interesting Southern farmers in a plan to convert unmarketable sweet potatoes into fine brown commercial syrup. Heretofore undersized potatoes have been discarded as waste or plowed in to fertilize the ground.

Pegs from Waste Lumber Save Railroad Ties

THE use of pegs cut from waste lumber to plug the holes left in railroad ties after the steel spikes have been pulled is one of the recent developments in the nation-wide movement for lumber conservation. The plugs serve to prevent the starting of decay in the ties.

In the lumber industry it is often necessary to alter rail lines, necessitating the pulling of spikes and relaying of ties. If the spike holes are left open, water soon enters and starts infection. By plugging up the holes a longer period of service is obtained from the ties.

The cutting of the wooden pegs from waste lumber is the result of an effort in wood saving and has received the hearty endorsement of officials of the U. S. Forest Service, which is seeking to conserve the diminishing lumber supply of the nation.

These pegs, cut from waste lumber, plug the spike holes in railroad ties

The ideal way to bathe. Exercise—running, splashing, swimming—drives the blood to the skin surface and prevents chilling

How to Take a Bath Scientifically

By Guy Otis Brewster, M.D.
Fellow American Medical Association

SOME of us bathe twice a day, some of us once a day, and some of us still stick to the old fashioned Saturday night schedule.

But most of us, I know, do not really understand how, when, where and why we should bathe—at least we do not understand the underlying scientific answers to these questions. Yet baths, particularly summertime baths at the seashore or in the mountains, may have a decided influence, for good or bad, on our health.

Once I had a patient—a member of one of America's most famous families—who took a cold plunge each morning and evening throughout the summer. He came to me complaining of fragile nerves. He was so irritable that his friends avoided him and his business associates quarreled with him constantly. The whole trouble with him was that he didn't know how to bathe. For him the cold baths were poison.

To keep well, every man and woman should understand the bathtub route to health—what a bath is and how it acts, its scientific reasons for being. And for such an understanding, a knowledge of the skin, its structure and functions, is essential.

This holds true at the bathing beaches, as well as in the bathtub. How many of us realize that there are more than 125 different kinds of skin diseases and disturbances, and that the majority of these diseases are treated by physicians immediately after the summer bathing season?

Most persons think of their skin merely as a covering or adornment for the body. As a matter of fact the skin is a highly sensitive and complicated system of nerves, fat, glands and blood vessels, designed for our protection. The outside layer of skin is a sort of armor made of a succession of plates overlapping each other like fish scales. The under skin is a layer of fat cells, ranging from one fourth of an inch to six inches in thickness. The distribution of this layer of fat is one of the causes of individual reaction to heat and cold, either from water or air.

I have a stout patient who never can be convinced that his slender little wife feels warm in light clothing in cold weather when he, heavily dressed, is suffering with the cold. The secret of her warmth is that she is a woman. Women are blessed with more evenly distributed layers of fat under the skin than men—a fact that is responsible not only for the more delicate contours of body and limb, but also for their ability to remain in the water at bathing beaches when strong men turn blue with the cold.

Between the outer, scaly layer of skin and in the inner layer of fat is an amazingly complicated system of blood vessels, lymph vessels, lymph spaces, oil glands, oil ducts, sweat follicles and sweat ducts. Upon the proper functioning of these depends not alone beauty of complexion, but also health and comfort. Improper bathing may seriously interfere with the normal operation of this intricate skin system. Proper bathing will aid it.

In the twenty square feet of skin in one's body are more miles of sweat and oil ducts than a person could run in a day. The small blood vessels of the skin twine around sweat follicles and oil glands so that perspiration and oil can be taken from the blood. Upon the proportionate mixture of oil and perspiration depends the softness and smoothness of the skin.

Now let's see how water of various temperature effects this intricate skin mechanism.

A typical crowd at the famous Coney Island beach, where more than 100,000 bathers splash in the cooling waters each day during the summer. Skin troubles are prevalent following the bathing season, physicians declare

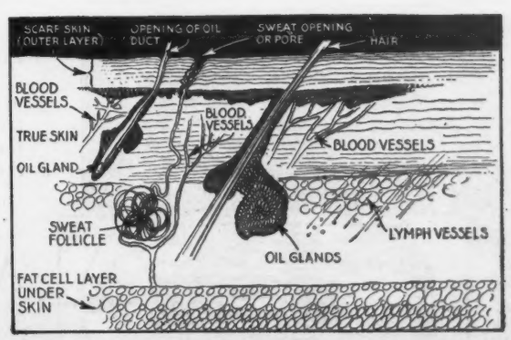
Do you know why you feel that pleasant warm glow a few moments after a cold bath? Cold water closes the skin blood vessels and drives the blood into the large arteries and veins of the body. Thus the surface of the skin becomes chilled. Temporarily there is nothing to warm it up. Meanwhile the internal organs are overheated because of the abnormal influx of blood. The return of this blood to the surface brings on the tingling, warm sensation that makes the cold plunge seem worth a moment or two of discomfort. Actually, that sudden shock of cold water may be distinctly harmful.

A hot bath reverses the process. It draws the blood to the surface. Then, when you step out of the bath and begin the rub-down, the evaporation rapidly cools the skin. Immediately the cooled blood travels inward, and you feel cooler, paradoxically, than you would after a cold bath.

Water that is too hot or too cold shocks the body, and should be avoided—a fact that is not understood or ignored by an amazing number of persons.

One of these is a noted polo player who came to me last October with a

(*Turn to page 99*)



The delicate construction of the skin, showing the intricate system of blood vessels, glands and ducts beneath the tough outer covering

© Herkimer

Arkansas Oil Gusher Demolishes Well,

ONE of the most spectacular oil well gushers in history formed this huge crater, 600 feet in diameter and 100 feet deep, in the famous Smackover field of Arkansas, where oil spouts from the earth at the rate of 100,000 barrels a week. The picture at the left shows the great gusher just as it became unmanagable, destroying the derrick and machinery before creating the crater. Eventually the well caught fire destroying hundreds of thousands of barrels of oil. Every known human agency was employed vainly to

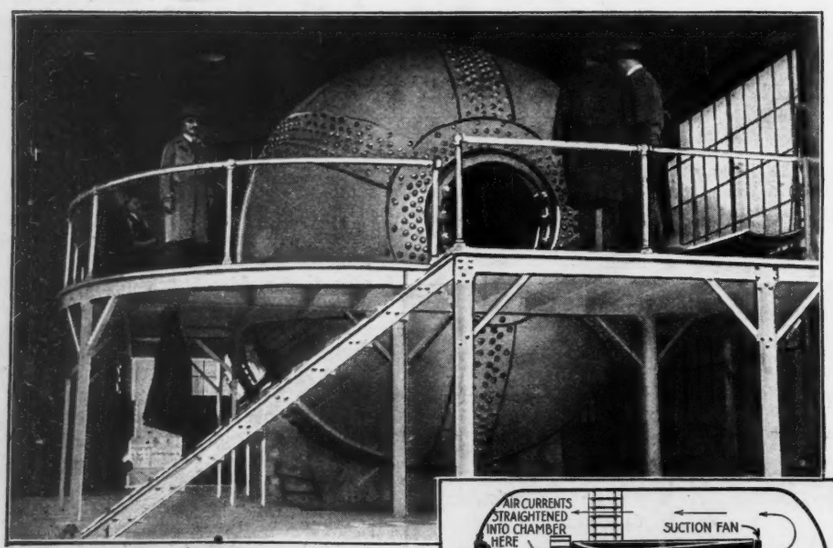
Compressed Air Tests Model Planes

COMPRESSED air is used to reproduce actual flying conditions in the newest type of wind tunnel, designed by Dr. Max Munk, technical assistant of the National Advisory Committee for Aeronautics, and recently operated for the first time at Langley Field to test models of aeroplanes and so determine the effect of varying air currents.

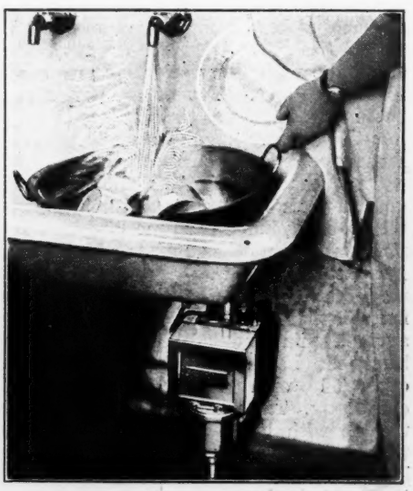
In previous air tunnels, which use air at atmospheric pressure, the data obtained gave only proportional results. It was necessary for designing engineers to compute from these figures the actual effect on a large plane. Dr. Munk conceived the idea that if the pressure were increased on the air as it rushed past the model, the effect would vary. After much study he was able to determine the correct pressure which would require no juggling of the figures obtained in a test of this kind.

The cylindrical air tunnel of five foot diameter, differs in construction from those already in use, in that it is contained within a monster compressed air tank in which the pressure can be maintained at from 300 to 450 pounds per square inch. The circulation of the air is obtained by means of a large suction fan that causes a velocity past the model of 90 miles per hour. From the readings obtained by instruments, determining drift, lift friction and other effects, the individual characteristics of any model are directly observed, without the necessity of scale corrections.

Various conditions can be simulated by varying both the pressure and the speed of the air. A combination of the two methods, it is said, will make possible more accurate study of air currents as affecting aeroplanes and will assist greatly in perfecting methods of airplane construction and the art of flying.



Inclosed in this huge compressed air tank is a cylindrical test chamber in which a model airplane is subjected to varying air currents. The air is circulated by means of a suction fan as shown in the diagram



Electricity Heats Water as Faucet is Turned

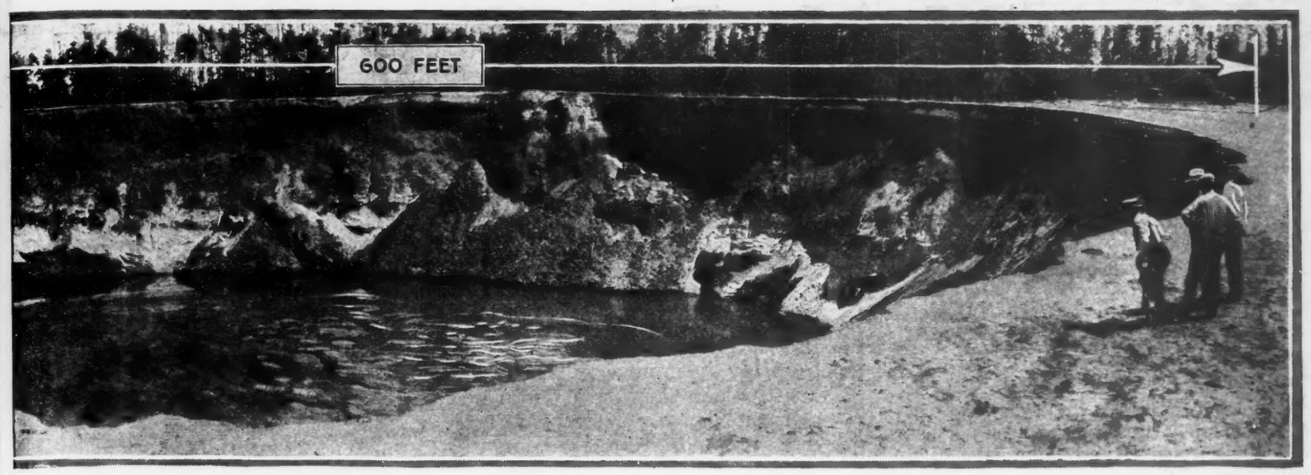
SIMPLY turning a faucet switches on the current of a new type of electric water heater and instantly supplies hot water for the kitchen, bath or lavatory in which it is installed.

Opening the faucet allows the water to flow through the heater and trip a switch as it flows. This causes the electricity to pass through sixteen heating elements that transmit their heat to the metal in the small tubes through which the water flows.

When the faucet is turned off, the switch flies back and turns off the electricity. The implement is said to be economical because of the fact that it heats only as much water as is wanted for immediate use. The elements cannot become overheated because the water is in direct contact and absorbs the heat as fast as it is generated.

Sparrow Is a Ragpicker

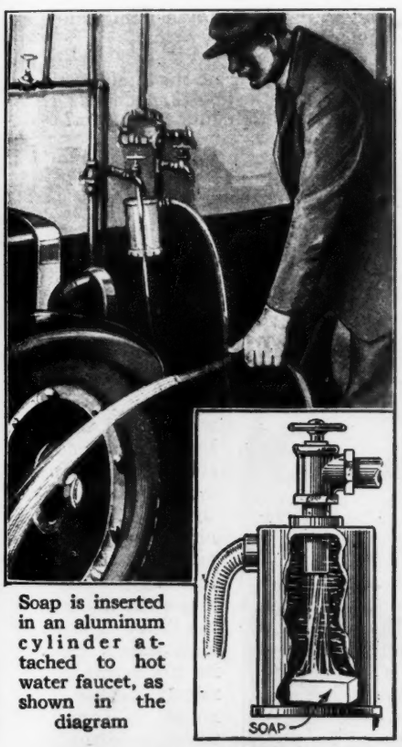
AN OLD sparrow's nest recently found in an apple tree at East Cleveland, York, England, was found to be composed of two shoelaces, an old railway ticket, three stamps, a safety pin, three pieces of red cloth, finger of kid glove, half a cigarette, part of a photograph, and half a yard of bandage.



Opening Huge Crater 600 Feet in Diameter

stop the fire. Finally the well "sanded up," accomplishing what man was unable to perform.

In this immense hole lie the derrick, boiler, tools, and tankage of the well. The crater was formed in about 24 hours, creating a spectacular display. Great quantities of mud and rocks shot skyward, and a geyser of water and oil spurted from the center until the throat of the monster became choked at the bottom of the well. The well was a total loss. But the vast hole in the ground has been purchased by a company which will use it as an earthen storage tank with a capacity of 1,500,000 barrels of crude oil.



Soap is inserted in an aluminum cylinder attached to hot water faucet, as shown in the diagram

Soapy Water Sprayed by New Garage Washer

A SIMPLE and yet effective method of cleaning oily and greasy machinery and garage floors has been achieved in the invention of a hydraulic washer by Wallace Miller of Colorado Springs.

The washer consists of an aluminum cylinder that can be screwed to a hot water faucet and has a removable bottom through which cakes of laundry soap can be inserted. A section of ordinary garden hose serves to spray the soapy water over the parts to be cleaned.

The force of the water entering the cylinder dissolves the soap. The jet of water from the hose quickly removes oil and grease from surfaces and out of crevices which it would be difficult to reach with a brush.

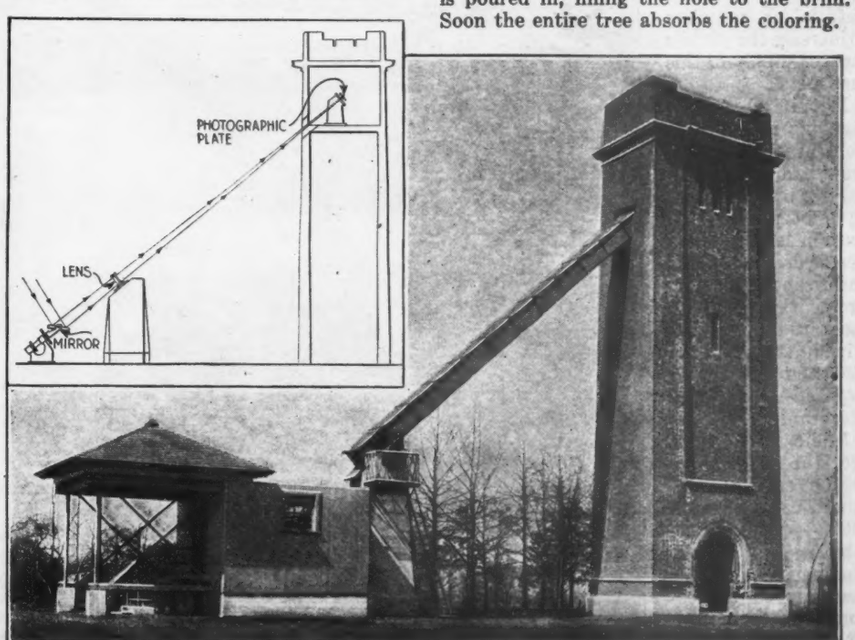
Largest "Upside Down" Telescope

THE perfect operation of the largest "upside down" telescope in the world was reported recently by Dr. Frank Schlesinger, director of Yale University Observatory, New Haven, Conn. The telescope is employed to determine the light-curves of faint, variable stars.

Advantages of the novel mechanism are convenience in operation and greatly reduced cost as compared with the telescope mounted in the usual way. In addition, it keeps the image stationary both in position and in orientation.

The telescope being used at Yale is described by Doctor Schlesinger as a Loomis "coelestat telescope" because of its ability to keep the image stationary. It consists of a 15 inch photographic objective and ten inch visual objective lens both of 50 feet focal length mounted in the same tube which is pointed downward. Images are "fed" into the telescope by means of a plane mirror thirty inches in diameter at the lower end of the tube. This mirror is rotated by clockwork at a rate of 360 degrees every 24 hours and objects are kept stationary on the plate by rotating the latter at the same rate.

Images from the lenses are formed in an observation room at the top of a massive tower 60 feet high. Electrical connections permit the observer to manipulate the telescope from the observing room.



The "upside-down" observatory at Yale University. Its operation is shown in the diagram

Dyes Tint Living Trees

COLORING the wood of growing trees with aniline dyes is one of the recent achievements of science in producing tinted lumber. Nearly any color can be used.

A slanting hole is bored through the foot of the tree trunk. After the lower end of the aperture is plugged up, the dye solution is poured in, filling the hole to the brim. Soon the entire tree absorbs the coloring.

How Much Do You Know about Science?

Thirty Questions and Answers to Test Your Knowledge

Answers to questions asked in this article appear on pages 97 and 98

HERE is the third series of Popular Science Monthly's simple, searching questions on the fundamental facts of science, selected from thousands of queries from our readers. Answer them to the best of your ability; then test your knowledge by reading the correct answers that appear on pages 97 and 98.

Electricity and Radio

SCIENTIFIC knowledge of electricity has been revolutionized in the past few years by the discovery that electricity is really composed of little particles called electrons. If anything is charged with electricity that means merely that it has electrons on it.

What do you know about them and about how they are applied to your everyday life?

1. How do we get electricity?
2. What is the difference between alternating current and direct current?
3. What makes the noise of thunder?
4. What makes the electric sparks when you stroke a cat?
5. What makes electric fuses burn out?
6. Why do electric light bulbs burn out?
7. What are radio waves?
8. Is it easier to send wireless messages in one direction than in another?
9. What is it you do when you tune a radio set?
10. Is there any danger of lightning striking the roof wires of a radio set?

What Is Life?

DID you know that the human body is made up of millions of little grains of living matter so small you can not see them without a very powerful microscope?

These little grains are called cells. The living matter inside them is called protoplasm. These cells make up all kinds of living creatures, even plants.

Scientists have learned recently that protoplasm is not a single uniform substance like wax or putty. It is a very complicated structure of tiny threads and granules and compartments much like the work rooms of a factory.

See how much you know about the wonderful workshops of your body.

1. Does all life come from previous life?
2. Has living matter ever been created artificially?
3. Why is water necessary to life?
4. Will monkeys ever become men?
5. Why does a cat always fall on its feet?
6. Can insects communicate with each other?
7. How do bees sting?
8. Why do moth balls keep moths away?
9. Why are holes put in the bottoms of flower pots?
10. What is yeast?

The Story of the Mind

WHEN we get into the story of the mind we deal with the most efficient part of the bodily machine. Certain electrical and chemical changes take place in the mind and we call them thoughts. Similar electrical or chemical changes are what direct the movements of the body and govern human action.

A whole new science has been built up around the idea that the mind can often act unconsciously.

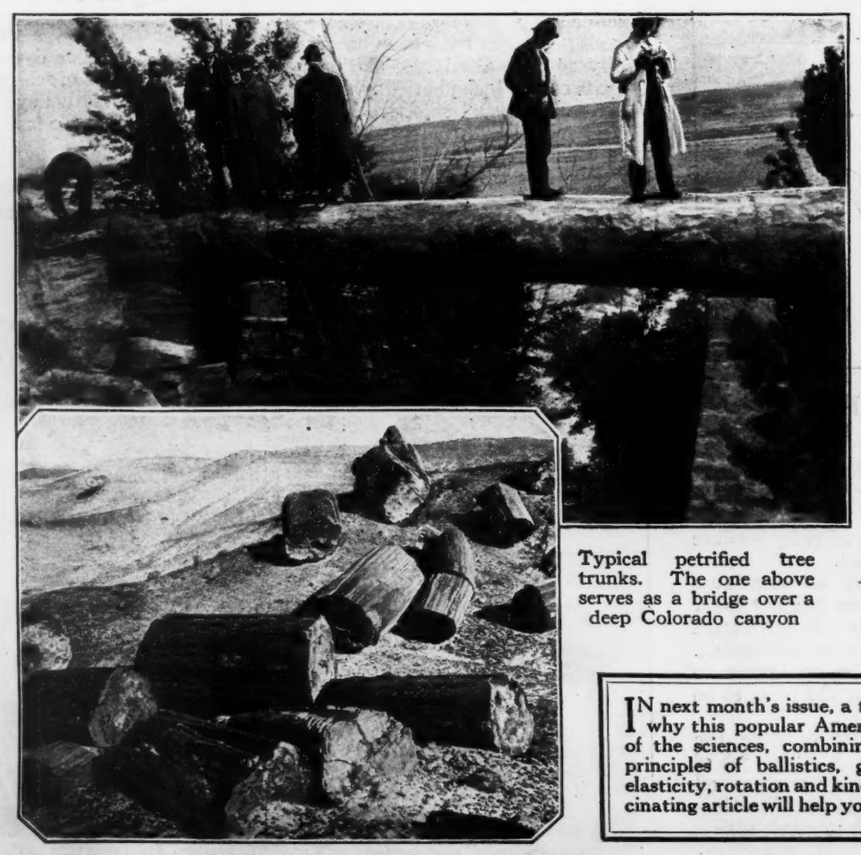
1. What is the brain made of?
2. What are the nerves made of?
3. Where do thoughts come from?
4. Can animals think?
5. What causes nervousness?
6. What is the unconscious mind?
7. What is psycho-analysis?
8. What is sleep-walking?
9. What makes a person blush?
10. Do babies learn anything the first year of life?

Scientists Mine Precious Radium from Petrified Trees

THAT precious radium can be extracted from the trunks of petrified trees found in Western Colorado is a comparatively recent discovery by scientists which promises to increase the world's meager supply of this rare metal.

Petrified trees, standing in the position in which they grew and completely covered by sandstone, have been found to contain large quantities of uranium oxide and vanadic oxide. From the first of these radium is obtained, 250 tons of the material being required to produce one gram of radium.

Millions of years ago, the movements of the earth's crust caused areas covered with vegetation to be submerged. Rivers, running into these tree covered depressions filled them with silt and sand. Gradually the loose sand was turned to stone by pressure and the cementing process due to chemicals in the water. The uranium compounds suspended in the water gradually were deposited in the cells of the trees. The wood disappeared, and in its place was left a mineral called carnotite, still retaining the form of the original tree.

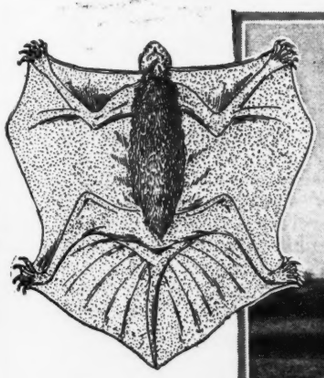


Typical petrified tree trunks. The one above serves as a bridge over a deep Colorado canyon

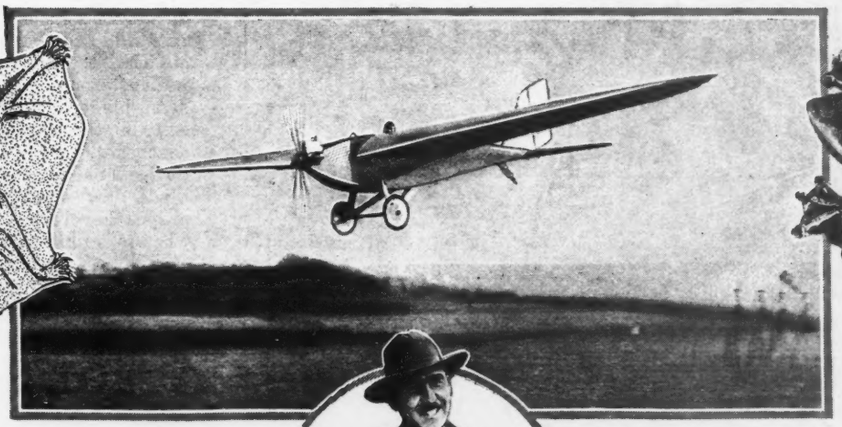
In time the water receded to lower levels, or the land rose and there remained the dry sandstone hills in which were imbedded the petrified trees, composed of carnotite and other mineral substance.

IN next month's issue, a tennis expert will tell why this popular American game is a sport of the sciences, combining a mastery of the principles of ballistics, gravity, momentum, elasticity, rotation and kinetic energy. This fascinating article will help you improve your game

How Nature Designs Living Gliders



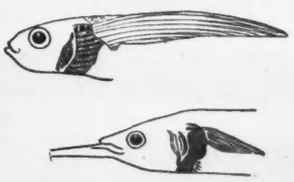
The flying lemur of the Sunda Islands in the East Indies, has a fold of skin extending from neck to tail and supported by the legs. When the creature jumps from a tree it spreads out this skin like a wing, gliding sometimes more than 200 feet in its descent



The gliders which man has invented to soar through the air without motor power, or with the aid of only small motors, have their counterparts in the animals and fishes shown on this page—nature's own living gliders

Above is the small motorized glider in which Georges Barbot, French aviator, recently completed a remarkable flight across the English channel. Barbot is shown holding the small 15 horsepower auxiliary motor

Large webbed feet serve as gliding wings for the flying frog of the Sunda Islands. In addition, when this strange creature jumps it fills the loosely folded skin of its legs full of air, like a dirigible, until its bodily surface area is increased almost seven times

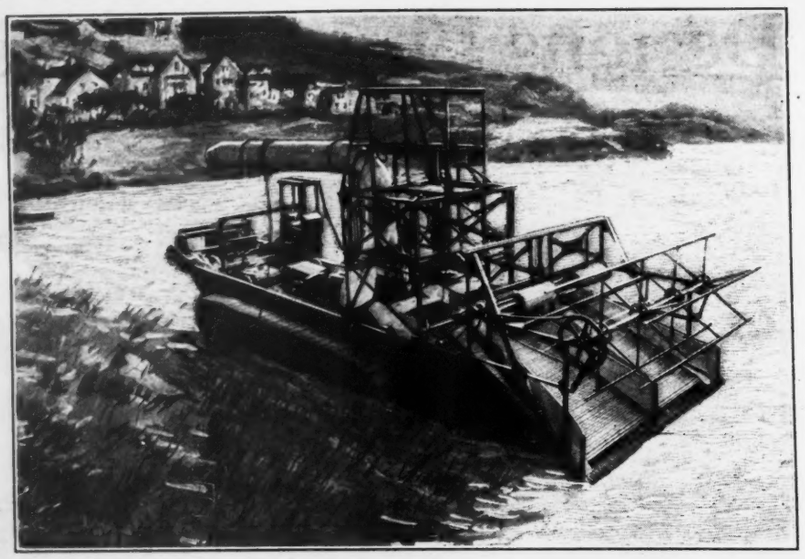


Above are shown the small muscles used by two types of flying fish in spreading the large pectoral or side fins for gliding. It is believed probable that the fishes also vibrate the wing-like fins while gliding. They can fly nearly 600 feet

The familiar American flying squirrel, shown below, often may be seen gliding through the air from the top of a high tree to some lower level. Peculiar cartilages attached to the base of its hands spread out a winged gliding membrane on each side of the body

Like the flying frog, this little gliding dragon called Draco, adopts the dirigible principle in flight. The usually rigid ribs are employed to spread out wing-like membranes from each side of the snake-like body. Simultaneously the dragon pumps these folds of skin full of air. When at rest, the wings are folded close to the body. These queer creatures are able to cover distances up to 60 feet in one jump

In this species of salt water flying fish, known as Exocoetus, the large side fins serve like airplane wings in prolonged gliding, as shown above. The tail fin drives the fish not only through the water but out of it. While the fish is swimming gliding fins are folded to the body. The tail fin drives like a propellor until the speed is increased sufficiently to hurl the fish out of the water. Then fins are spread



Harvester Travels on Land or Sea

A SEA and land boat goes into operation soon at Leesburg, Fla., for harvesting of sawgrass, used in the manufacture of paper pulp. The machine reaps the grass and conveys it into the hull, where it is cut and blown into a freighter hold.

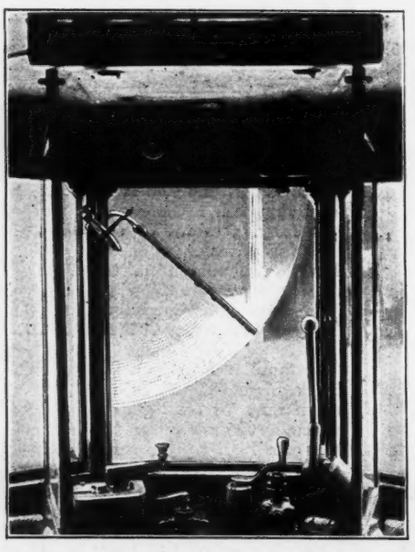
When afloat, the machine is propelled by two stern paddle wheels. A pair of continuous treads operate it when near the shore. The body is a flat bottomed boat. A frame on the forward end carries a cutter bar and overhead reel like a reaper, hinged so that they can be raised or lowered to suit existing conditions.

The machine has eight speeds forward, two reverse, and a draft of 35 inches.

Car Window Wiper Helps Motorman

ON THE street cars in Milwaukee, Wis., a novel glass wiping device recently has been installed to keep the motorman's window free from rain and sleet. The wiper makes it possible to clean the outside glass surface from within the car. It is operated by slightly turning a handle located on the inside of the window frame.

The wiper itself is formed of a strip of rubber in a metal holder and it moves radially in a vertical plane across the glass surface. The metal holder is attached to the outer end of an arm of steel which passes through the window framing. The device serves as a protection to pedestrians who might otherwise be obscured by rain, snow or sleet on the car window as well as a safeguard for those within the car. Photograph at right shows the device in operation.



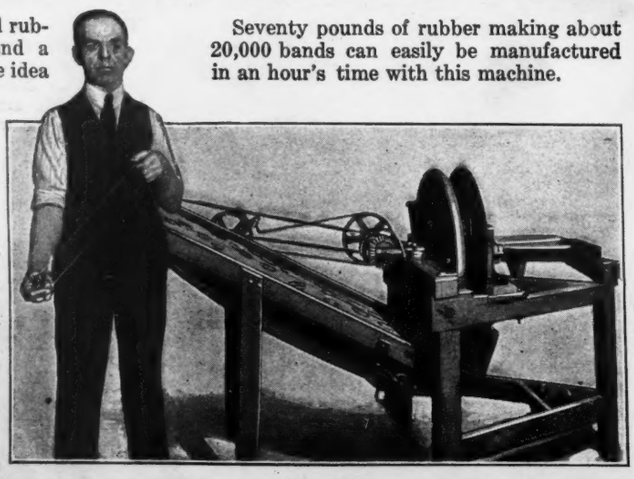
DESIGNED for fast freight service, an eight-wheel motor truck has been put in operation in San Diego, Calif. Its speed is 35 miles an hour.

Rubber Bands from Old Inner Tubes

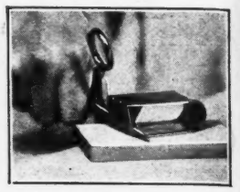
A WAY to utilize old rubber inner tubes and a machine to carry out the idea have been invented by C. B. Martin, of Canton, Ohio. The machine is designed for cutting tubes cross sectionally into bands by means of a circular knife.

Bands of various sizes may be cut from bicycle, motor-cycle and automobile tires. The inventor in the photograph at the right is shown testing one of the bands cut by machine from tire.

Seventy pounds of rubber making about 20,000 bands can easily be manufactured in an hour's time with this machine.

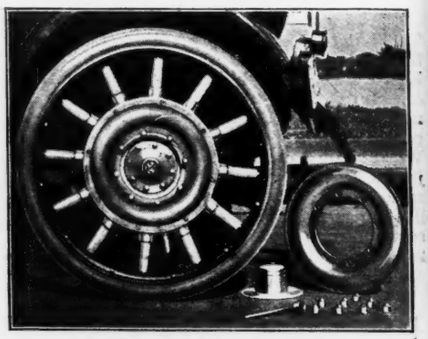


Simple Scissors Sharpener Produces Keen Edge



A FEW strokes over a hone are said to be sufficient to put a keen edge on scissors blades inserted in this new sharpener. The device holds the blade at the proper bevel to produce a cutting edge when it is pushed over the hone.

Hub Tire Absorbs Shocks with Less Wear



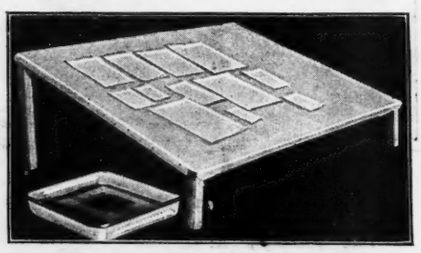
TO PREVENT punctures and wear without eliminating the desirable qualities of the pneumatic automobile tire, a Baltimore manufacturer has devised a pneumatic tube that fits around the hub instead of around the rim of the wheel. A solid tire is used on the rim.

The new tire is a combination of tube and tire. It carries the pressure of the spokes from the outside just as ordinary tires do from the inside. The rim of the wheel is fitted with a narrow solid rubber tire such as is found on trucks.

The solid tire on the rim wears longer and has less retarding tendency than a pneumatic tire. At the same time the inner cushion about the hub serves as readily to absorb the shocks.

The illustration shows the tire both when in place and when demounted.

Cheese Cloth Table Dries Camera Prints Quickly



A HOME made camera print drier which overcomes the amateur's usual difficulty of rapid drying, performs the operation without causing the films to curl.

A square frame made up of four pieces of wood is set upon four legs, two of which are longer than the others to permit the liquid to run off the surface. Cheese cloth is stretched over this frame and upon the cloth the prints are laid, picture side down.

The circulation of air through the cloth facilitates rapid drying. The fact that prints can be dried with the picture side down prevents curling and settling of dust on the surface.

Your Brakes and Your Safety

How Every Motorist Can Insure Against Costly Accident by Simple Methods of Inspection and Repair at Home

By F. A. Platte
Instructor, Physics Department, Columbia University

YOU are driving at moderate speed, say 30 miles an hour. The road is clear.

Suddenly a large truck backing out of a side lane, emerges with a roar about 70 feet ahead on a stretch of road where you can't turn out.

Instinctively you jam on your brakes and pray they will hold.

But do you *know* they will?

In the answer to this question lies the safety not only of yourself but of others. You may find yourself in this situation any day. Even in the course of an ordinary day's driving you are forced to stop suddenly many times. If you don't *know* your brakes are in perfect condition—if you only *think* they are, you have no right to drive a car.

You may pay for your carelessness at any moment with your life. Or you may take the life of another. It is a needless risk, when brake inspection and adjustment are so simple.

Most drivers have some idea of the principle of the automobile brake. It consists of pressing a stationary surface against a revolving drum, and thus retarding the drum by the force of friction. There are two points on each rear wheel of the ordinary automobile where this friction is applied; the outside of the brake drum, where the foot brake band grips, and the inside of the drum, where the band of the emergency brake functions.

All that is necessary, then, to have brakes in perfect condition is to see that the friction is applied properly. And the factors on which this proper application depends include proper clearance between the drum and bands when the brake is released; even distribution of friction surface all around when the brake is applied; drum and brake linings free of oil and grit, and linings that are not too worn or smooth.

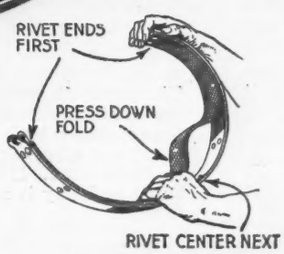
When an automobile is delivered by a manufacturer the brakes, in most cases, are perfect in these respects. Usually they are adjusted and ready for action. After that it is up to you to keep them so.

When brakes hold the balance between life and death. Even for the careful driver there comes a time of unforeseen emergency—a child running across the road, a truck backing into the highway—when his safety and the safety of others hangs on the ability of his brakes to hold. Careful inspection and repair of worn brakes is the best insurance against injury or death

This entails periodic inspection on your part. From the very start make it a practice to inspect your brakes frequently. Don't wait until an accident jars you into it. In this inspection the most important item is that of clearance, for most of the trouble with brakes is caused by the bands being too loose or too taut.

The correct clearance between the band and the drum is about 1/64 of an inch and it should be uniform all the way around. If it is not uniform the brake lining will wear in one place, while the rest of it will fail to function properly when the brake is applied. If the band is too tight it will "drag" and suffer needless wear. If it is too loose it will fail to grip the drum hard or fast enough when you want it to.

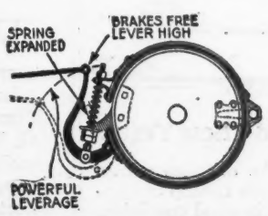
The amount of clearance also has an important bearing on the rest of the breaking mechanism of the car. A brake band that is too loose requires abnormal pressure on the brake pedal. This pulls the rods and levers out so they approach a straight line, and lose the leverage necessary for the most efficient braking power.



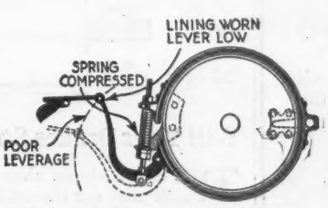
To install a new brake lining, cut the lining about ¾ inch too long. First rivet ends flush, then press out fold, causing lining to cling to band. Start riveting from center

Clearance inspection is an easy job. With the ordinary artillery or wire wheels you need simply look between the spokes to examine your brake drum and see how far the bands and drum are separated. If your car is equipped with disc wheels it will be necessary to remove them for a clear view of the brake, a task that requires only a few minutes.

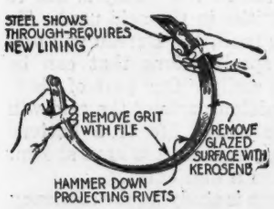
If you find your brake has not the proper clearance what then? The answer is found in those two little nuts above and below the spring at the open end of the brake band. They are the adjusting nuts. A turn one way will loosen them and give additional clearance to the band. A turn the other way will tighten the band. The spring is there to keep the brake lining away from the drum when the brake is released.



A service brake in good condition. The powerful leverage is certain to stop the car quickly



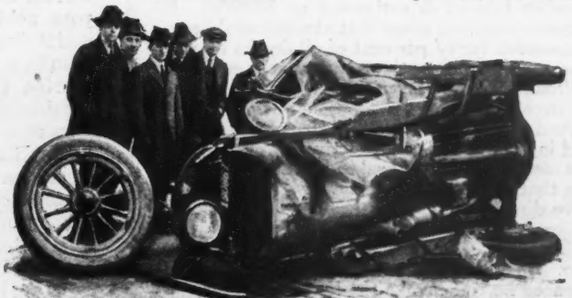
A worn service brake. Adjusting will not make it work efficiently, for the spring is completely compressed, as shown above


STEEL SHOWS THROUGH-REQUIRES NEW LINING
REMOVE GRIT WITH FILE
REMOVE GLAZED SURFACE WITH KEROSENE
HAMMER DOWN PROJECTING RIVETS

How to remedy various defects in a worn brake lining. Poor adjustment causes excessive wear in one place. Always maintain an even clearance of about 1/64 inch between lining and drum

If the clearance is all right, if the friction apparently is distributed evenly when power is applied, and still your brake doesn't function properly, then turn your attention to the condition of the lining. Even the greatest of care in washing and oiling the car will not prevent grit and oil from working in on the brake lining. By unscrewing a few nuts on the brake band you can remove the band readily for inspection of the lining.

If the surface of the lining is glazed by oil the finish can be restored by soaking the lining in kerosene. The oil that causes the trouble usually can be traced to the rear



When brakes failed on a downgrade, this machine crashed into a street car, killing one man and permanently injuring two others at Cincinnati, Ohio

axle. A new washer between the axle housing and brake drum should rectify this trouble. A file will remove any grit that may have become embedded in the lining.

If the brakes are cleared regularly, especially after long trips over dirt roads, their life will be greatly lengthened. But even with the best of care, the brake linings in time will become too worn to permit adjustment and will have to be replaced.

Replacing brake linings can be done in the home garage. First select a good lining. The best types are made of asbestos, with a woven copper wire base, and are waterpoof. Care should be taken to order the proper width. Most manufacturers issue charts indicating the exact width of linings to be used with each model of car. If you haven't access to such a chart be sure to measure your lining accurately, then order about 1½ inches more in length than the inside circumference of the band. You will see why presently.

Installing New Lining

After removing the band, place it in a vise and clip off the rivets that hold the lining with a cold chisel. The old lining then will drop out.

Now you are ready to install the new lining. Cut it so that it will project ¾ of an inch beyond one end of the band, the other end being flush. Now draw this projecting end back and rivet it so that both ends of the lining will be flush with the corresponding ends of the band. Naturally a loop, or hump, will remain somewhere in the circle between the ends. This is where your extra length comes in. Press this down. You will find it compresses just enough to make a tight fit against the band all the way around. This will obviate the possibility of hollows which would impair the efficiency of the brake.

Center Rivets Come First

Up to this point only the ends of your lining have been riveted to the band. Now complete the riveting all the way around, first putting in the center rivets, then the remaining rivets midway between those already in. If you rivet from end to end in one direction you will have trouble compressing your lining evenly.

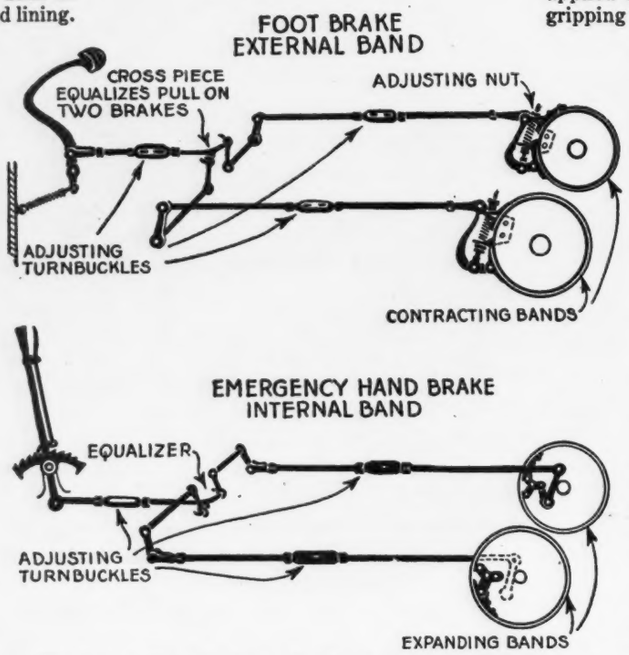
The rivets, of course, should be countersunk. That is, the head, always placed on the inside, should be set in about half the thickness of the lining. You can provide for this with an ordinary countersink when drilling the holes for the rivets. This is an important point, because if the rivet head is flush with the inner surface of the lining it will lessen the friction on the drum because of its smoothness, causing the brakes to screech when they are used.

Having fitted your new lining, replace the brake band by screwing back the nuts you took off to remove it. When this is done both rear wheels should be jacked up; and you will need a helper for the final adjustment. He should be in the front seat to step on the brake pedal while you turn the wheels by hand. Carefully turn the adjusting nuts on both brakes until the resistance is the same on each wheel when the pedal is depressed. This is important, because if the brake is tighter on one wheel than on the other it is likely to cause skidding to one side as well as reducing the braking power.

When everything is adjusted run the car out on a dry pavement for the final test. Drive about 20 miles an hour and apply the brakes. See if you can stop within 30 feet. Try this several times, starting and stopping quickly. If your car stops within 30 feet your brakes are safe.

Now for the emergency brake. This operates inside the drum, deriving its friction by means of an expanding shoe. That is, your emergency lever forces the lining against the inside of the drum by power applied as a push from within, instead of gripping the outside with a pull, as in the case of the foot brake.

Since the emergency is used infrequently, compared with the foot brake, it seldom needs adjustment. You can tell whether it is in order by trying it out on the road. If it does not work properly, the best thing is to let an expert fix it, since it is much harder to repair in the home garage than the foot brake.

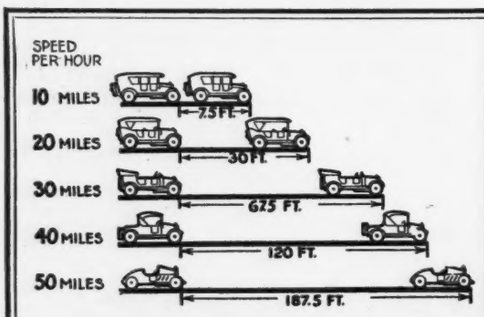


The upper diagram shows the three adjustment devices of the service brake; the lower diagram, the two adjustments of the emergency brake. The turnbuckles usually should be left alone, and adjusting should be done by turning the nut near the brake band. If this will not accomplish the purpose a new lining probably is needed to make the brakes work right

What to Let Alone

We have considered here only the friction parts of the brake. In addition to these parts there are brake rods, levers, threaded forks and turnbuckles, which constitute important parts of the braking mechanism. These, however, should be left strictly alone. They will have been adjusted by the manufacturer so as to produce the best possible leverage on the brakes. Any unskilled tinkering is likely to throw this leverage out of position and as a consequence you may find yourself exerting a straight pull on your brakes instead of getting the advantage of a lever. Your braking power thus will be diminished.

If your brakes are so worn that you find it necessary to shorten the rods by manipulating the turnbuckle—that threaded connection between the two parts of the rods—what you need is new lining.



Will Your Brakes Stand These Tests?

THE chart above shows the distance within which your car should be able to stop at various speeds, if the brakes are in good condition. Will your brakes stand the test? Try them out and see. It may save you a serious accident.

More than 14,000 persons were killed in auto accidents in the United States last year. The number injured is estimated at 350,000. Insurance statistics show that the automobile was responsible for 67 per cent of all deaths by vehicles, more than four times the number caused by railroad trains and seven times the number caused by street cars.

And the blame for the majority of these deaths and injuries is laid to ineffective brakes. In fact, the menace of faulty brakes has become so serious that a number of the larger American cities have directed campaigns against them. Of 806 brakes tested during a recent "brake test week" at Trenton, N. J., 262 were found to be defective. The state registrar of Massachusetts announced he will revoke the licenses of motorists who drive with bad brakes. And in New York City drivers are being fined every day because their brakes are not in condition.

U. S. Bureau to Lengthen Life of Batteries

"WHY storage batteries fail at critical times," is the subject of a searching investigation recently undertaken by the United States Bureau of Standards under the direction of Dr. G. W. Vinal in an effort to save automobile owners inconvenience and expense. These researches, it is expected, will lengthen the life of all automobile storage batteries.

Battery failure frequently is due to small impurities in the acid used. To correct this fault, the Bureau will prepare acid specifications that can be maintained easily. One part of platinum in a million parts of the acid will shorten the active life of a battery considerably, experiments have shown. Iron also has a bad effect.

The Bureau is studying the efficiency of commercial electrolytes sold under trade names and frequently colored gaudy hues. Some of these, according to Doctor Vinal, are damaging to batteries because of impurities present. Tests are being made of commercial batteries in common use. Only about half of these come up to the performance standards set by the Bureau in various branches of military and civil service

Stock Feed Value Tested by Goats' Breath

UNUSUAL experiments in feeding animals are now being made in Scotland to determine the best and most economical method of stock-feeding and to reduce loss of animal life through nutritional diseases.

Goats are used chiefly in these experiments. To the horns of the animal is attached a mask provided with an inlet valve which admits air and another valve which passes expired air into a rubber bag.

When expired air is analyzed the amount of heat produced by the animal indicates the amount of food being used up. Whether the food supply should be increased or decreased is thus determined. Various kinds of food are tested also.

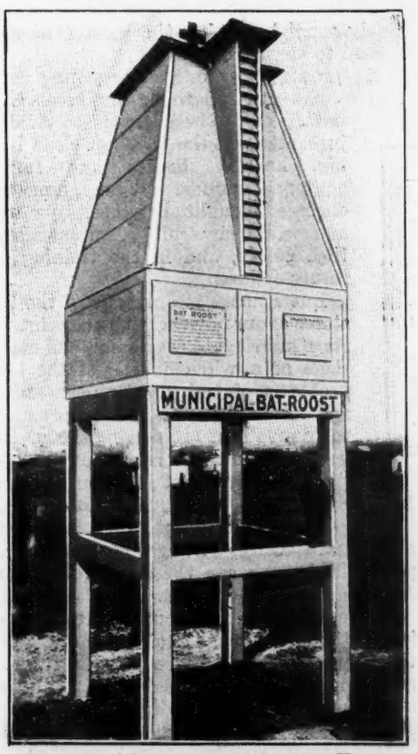
Knowledge of nutritional disorders is especially valuable since much ill health of human beings is believed to be due to mal-

Taking temperature of a goat's breath

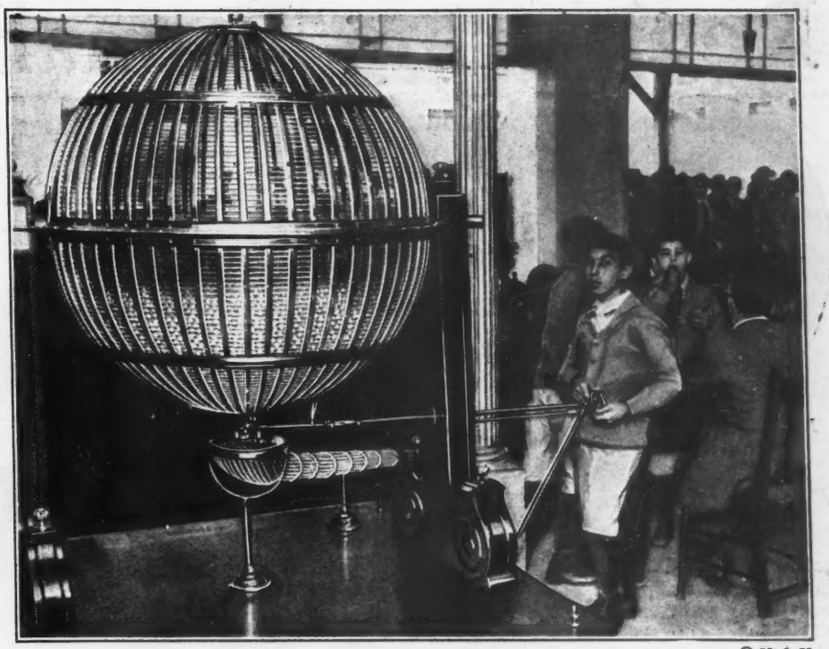
nutrition. By learning the causes of the diseases in animals scientists believe that many human disorders may be prevented.

Texas Cities House Bats to Fight Mosquitos

A MUNICIPAL bat roost at Austin, Tex., houses thousands of bats, each of which eats an average of 260 malaria mosquitoes a night. Since scientists say that a colony of bats will eradicate malaria in any locality, the animals are housed and protected in Austin and other Texas cities.



Municipal bat roost at Austin, Texas



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Orphans Draw Prize Numbers in Cuban Lottery

ORPHAN boys are employed to draw the lucky numbers in the Cuban National Lottery, using the elaborate apparatus shown above. Of two globes, one inside the other, the larger contains hundreds of small balls marked with the numbers in the lottery. The smaller globe contains other balls marked with prize numbers.

After the globes have been spun, a boy releases a trap at the bottom, allowing one lottery ball and one prize ball to roll out. The winning number draws indicated prize.

Two-Acre "White Horse" Etched on Chalk Cliff

THE White Horse of Kilburn, situated on a chalk cliff in Yorkshire, England, is badly in need of a new coat. This may not mean much to Americans, but is interesting to all Yorkshiremen.

The White Horse was formed by cutting away the turf on the hillside, revealing the white chalk underneath. It covers an area of two acres. But every so often the people gather to "scour" the horse. This is done by cleaning out the hollow so as to preserve its form. The plot occupied by the horse covers about 2 acres.

© Harrogate Herold

Realistic Witches Mark Boundary of Salem

REALIZING that touring automobilists are often in doubt as to when they enter or leave a city, the Chamber of Commerce of Salem, Mass., has erected a series of original and unusual boundary markers.

The markers typify two characteristics for which Salem is noted—her old fashioned Colonial doorways, and witchcraft. The doorway and steps of each marker are about 20 feet high and the figure of the witch is more than life size. The design is painted so cleverly and in such perfect perspective that it looks real to tourists who pass along the road 30 feet away.

DID you know that a human poison factory, capable of causing serious disease, lies concealed in decayed teeth and infected gums?

In an early issue of POPULAR SCIENCE Monthly, Dr. Edwin F. Bowers, an authority on the subject, will describe the newest scientific discoveries about our teeth and how to care for them.

One of Salem's witch boundary markers

Registering Human Pedigrees

How Kansas Developes Fitter Families; A Remarkable Experiment in Eugenics

By Arthur Capper, *U. S. Senator from Kansas*

Mrs. Mary T. Watts, Audubon, Iowa

The Eugenics Building at the Kansas Free Fair, where families are judged and registered. Seated in the center is a "fitter family" surrounded by examiners

Dr. Florence B. Sherbon, University of Kansas

THE average American family of today is the result of haphazard mating. Men and women marry with little scientific thought as to their physical and mental fitness for bearing and rearing children. When the children come they too often are brought up in the same haphazard fashion in which their parents chose each other. Is it any wonder that the number of mentally and physically unfit increases?

For years, American farmers and breeders have used scientific methods in the development of their livestock. Millions of dollars are spent every year at local, state and national fairs and livestock shows in judging and scoring the blue blood of the livestock world. The standards of breeding have been raised steadily through the years.

But what have we done for American children and their parents in encouraging periodical physical and mental examinations, the keeping of family records, and the use of scientific standards in choosing the parents of future generations? We have done much, but as yet our accomplishments cannot compare with what has been done for the lower orders of creation. It is unthinkable that the breeding of the human race should be placed on the unfeeling basis applied to livestock, but is there not much legitimate, unobjectionable work to be done in judging and scoring families not only on their present mental and physical condition but on the blood, training and achievements back of them?

The answer to this well may be found in the "Fitter Families" contest conducted annually at the Kansas Free Fair under the direction of the two women who originated the "Better Babies" contests which have become so popular all over the country—Dr. Florence Brown Sherbon, of the University of Kansas, and Mrs. Mary Terrill Watts, of Audubon, Iowa.

Their work with babies convinced them that to do the maximum amount of good, the entire family must be brought before the judges. The opportunity came in 1920 with the invitation by the secretary of the Kansas Free Fair at Topeka to "put on some stunt" during fair week. The contest, with the motto, "Fitter Families for Future Firesides," was decided on and an entire building was turned over to them at the fair.

"It can't be done," declared some. "You can get the baby for examination and scoring for he can't help himself, but when you ask for the entire family they just won't come."

But results proved these assertions wrong. In three years 75 families—a total of approximately 300 persons—have been examined and scored, and fully twice that number turned away. Professional men and women have given their services gladly. A staff of 18 men and women handle the examinations and tests.

The examination and tests occupy approximately three hours of each individual's time. When completed, the results justify the effort, for the 12 pages of the record contain a complete statement of the known history and the present mental and physical condition of the entire family. The history blank bears a full account of the health, education and achievement of every member of a family. Another sheet of the record shows the results of the intelligence test, and an examination by a psychiatric specialist of the nerve reflexes, emotional and intellectual responses. A thorough structural examination is made, including strength tests and measurements. The medical record gives the results of a complete physical and organic examination, with blood pressure, hemaglobin blood test and the Wasserman blood test. Every member of the family is examined by a dentist and an eye, ear, nose and throat specialist.

The fact that families return for a second, and even a third examination, shows the parents are genuinely interested in rearing young men and women who are physically, mentally and morally fit to assume the future of the nation. A tremendous forward step has been taken in Kansas, and there is no doubt that from its comparatively small beginning the movement will spread to large proportions.

No growing boy or girl or young man and woman can fail to be impressed and influenced by these lessons, so vividly presented, on the value of clean living, healthy bodies and fully-equipped minds. The germ of eugenic thought has been planted and will bear fruit when marriage time comes, and in the training of future children.

But Kansas is only one of the 48 states of our nation. Numerous interstate marriages occur daily, and marriage as a whole is one of the big problems of today. Uniform state and national marriage laws promise to do much toward solving this problem, but we must rely upon education as the greatest force for obtaining the maximum benefit from such laws.

Sweeping reforms cannot be accomplished overnight. Only through conscientious, painstaking work can the standards of the American family be raised.

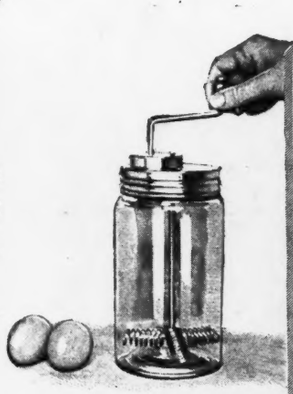
There should be no thought of eliminating sentiment from the choice of mates and the bringing forth of children, but the future generations can be trained to give these matters the serious consideration they deserve, instead of following the blind sexual impulses which so often control marriage.

THREE years ago a "Fitter Families" contest—involving the scientific registry, judging and scoring of husbands, wives and their children—was put on as a "stunt" at the Kansas Free Fair.

Next month this startling experiment in eugenics will be a center of nation-wide interest when the Kansas Fair opens. The movement which began in a small way is meeting with tremendous national approval.

Will the scientific judging of families raise the standards of human breeding, just as live stock shows now are improving our herds? Read Senator Capper's answer and see what you think about it.

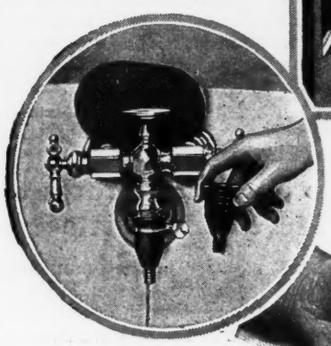
Science Lifts the Housewife's Burden



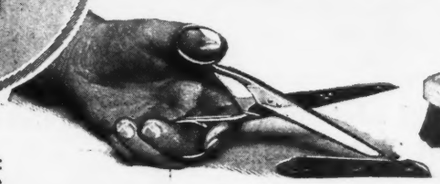
A revolving coiled spring enclosed in a small jar is the working unit of a new time saving egg beater. The spring, moving from top to bottom, strikes contents eight times with one revolution

The door of the kitchen cabinet serves as a convenient breakfast table in a newly designed built-in unit for the home. The seats shown above fold back against the wall, completely out of the way

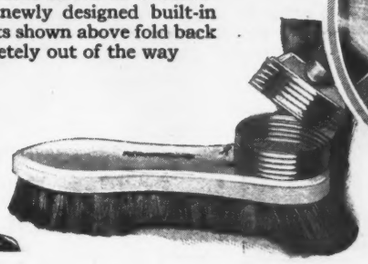
This handy milk bottle opener consists of a semicircular metal band attached to a pointed handle that is pushed down through the pasteboard cap. Raising the handle removes cap instantly



The universal faucet connection shown above is designed to fit faucets of any size. It can be used for attaching a bath brush or spray, shampoo spray or shower bath. Cross section shows the graduated interior surface of rubber

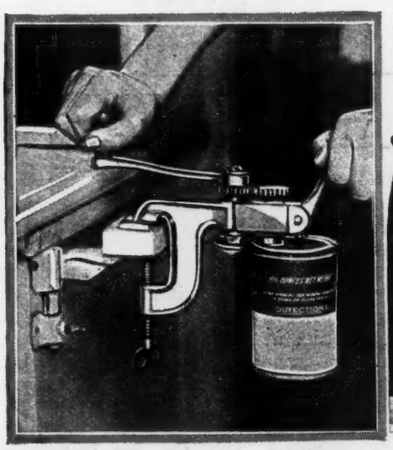


The safety razor idea now is being applied to scissors. A new blade is inserted by removing center screws and snapping it in place



A container fixed to the top of this self-soaping scrub brush is filled with soft soap. Screwing down the container cap forces soap to the bristles through a hole in the top of the brush

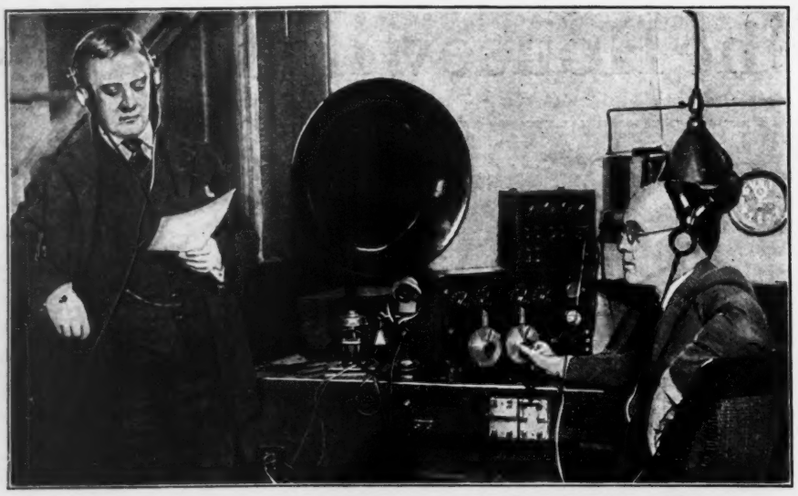
This ironing board is equipped with electric socket and switch which save steps in turning the current for the iron on or off. Through the socket the wire can be connected with any source of current that is within reach of the user



A left turn of the handle opens this can opener for inserting a can. A right turn cuts the can top off cleanly. The device is clamped to the kitchen table

The top of this dining room table tips back in such a way that the table can be moved easily through any doorway or even rolled into a narrow closet for storage

Combining washtub, boiler and washboard, this convenient utensil for the kitchenette has a fluted interior surface for scrubbing. It rests on the kitchen chair



New Postmaster General Is Radio Fan

DAILY reports from branches of the postal service and from the mail plane service in all parts of the United States now are received by radio in the Post Office Department at Washington, D. C. The new postmaster general, Harry S. New (at left) is shown listening in on the reports. Seated at the radio desk, tuning the receiving instrument, is the second assistant postmaster, Col. Paul Henderson.

Portable Loop Aerial Set Covers Long Distances

RECEPTION over distances of more than 1000 miles using a loop aerial is attained by Rutledge Mayo, of New York City, with the set pictured below.

The self-contained loop aerial is shown in the back of the cabinet. The set consists of three stages of radio frequency, detector, and two stages of audio frequency amplification.

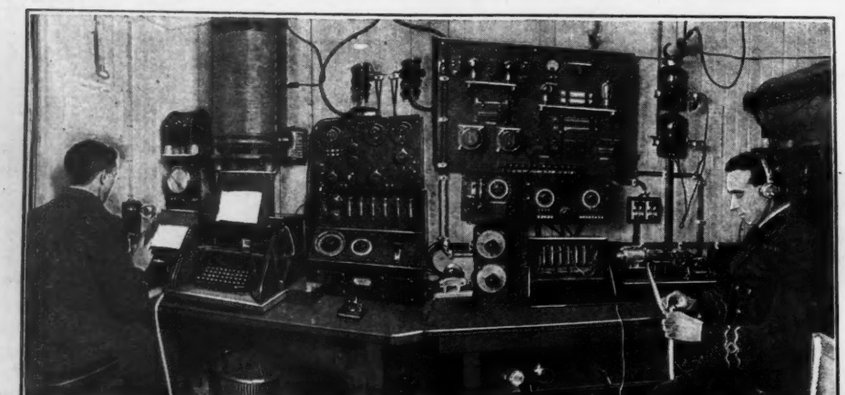
London Dog Listens to Broadcast Bat Calls

TO TEST out a theory that the calls made by bats are heard only by animals, bat calls were broadcast by radio recently in an interesting experiment at London, England. Receiving phones were placed on the ears of dogs. The attitude of the airdale in the photograph indicates that he has heard the bat calls as he is sniffing the air to find the bat's scent.

Liner Majestic Has Automatic Radio Sets

THE great White Star liner Majestic recently has been equipped with automatic transmitting and receiving sets which permit the sending of radio messages at the speed of 80 words per minute when the vessel is 1000 miles at sea. The receiver prints the dots and dashes on a tape which later can be deciphered at leisure.

The apparatus receives the words faster than a man can decipher them.



The Majestic wireless room, showing automatic transmitting and receiving instruments

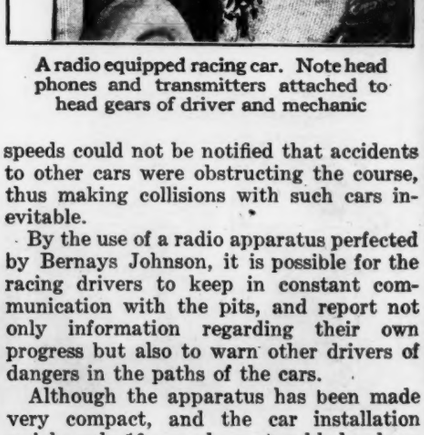
Crew of Submarine Enjoys Radio Concerts

THE joys of radio now reach even the crews of Uncle Sam's submarines. While the S-50 lies at the New York Navy Yard, at Brooklyn, N. Y., the crew sets up its outfit on deck and gathers about the loud speaker to enjoy news and entertainment sent out by powerful broadcasting stations in the vicinity of New York City.

Radio on Racing Autos to Prevent Accidents

THE latest addition to the innumerable new uses for radio is its installation on racing automobiles and in race track pits.

Many accidents in racing have been due to the fact that drivers going at terrific speeds could not be notified that accidents to other cars were obstructing the course, thus making collisions with such cars inevitable.



A radio equipped racing car. Note head phones and transmitters attached to head gears of driver and mechanic

By the use of a radio apparatus perfected by Bernays Johnson, it is possible for the racing drivers to keep in constant communication with the pits, and report not only information regarding their own progress but also to warn other drivers of dangers in the paths of the cars.

Although the apparatus has been made very compact, and the car installation weighs only 10 pounds, no trouble has been experienced by either drivers or pitmen in establishing and maintaining communication with each other.

This device will doubtlessly prevent many accidents on the race track.

Around the Radio Circuits

with Jack Binns

First of a Series of Articles Explaining New Hook-ups

FOR the average radio fan —especially the man or woman who is just beginning to master the principles of radio science—there is no better receiver than the simple single circuit set. I have consistently advocated this type of circuit for best all-round results; and even the recent interesting developments in new fangled "trick" circuits have not altered my belief. In fact, careful analysis of distant reception reports seems to show conclusively that the most consistent long distance results are being obtained with the single circuit regenerative receiver, while the more complicated circuits trail far behind.

Evolution in New Hook-ups

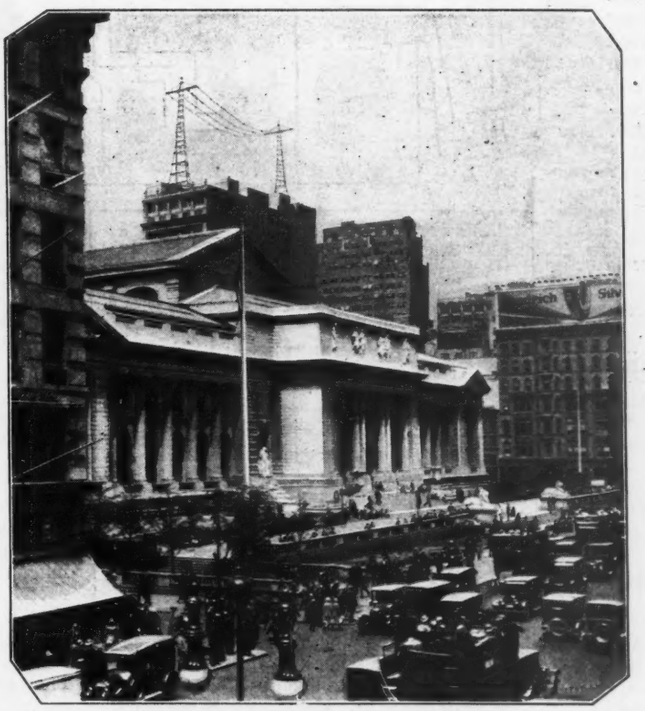
Yet there is another important factor, aside from consistent results, that cannot be overlooked. It is the tremendous lure of radio. The real fascination of trying new "stunts," of arranging parts in new ways, of testing out new hook-ups, grips the imagination of every radio fan.

Nearly every man in radio starts with a simple receiving set. It is like a new plaything. Once he has mastered it, he experiences a burning desire for a more powerful receiver. If he is a New York man, for instance, he is eager to spread his net beyond the New York and Newark broadcasting stations. He adds new parts and tries the new trick hook-ups. He sets out to get Schenectady, Pittsburg, Chicago; then San Francisco, South America, Honolulu. And never will he be satisfied until he hears around the world.

There is little doubt that new circuits constitute the present ruling passion in radio. And who will say that the new hook-up fever is not an entirely laudable one? Who knows but what it will result in achievements of permanent value in radio science? It spells radio evolution and the evolution of the radio fan.

For these reasons, in this and subsequent articles I am going to describe and explain the various types of circuits, beginning with the single regenerative circuit, and concluding with the complicated neutrodyne receiver.

It may surprise most radio fans to learn that when we go about the study of the new circuits in a systematic manner we discover that all of them are related to some fundamental "hook-up." It is only when we look at them separately that they seem mystifying. So it is my purpose to point out the close relationships between the new circuits. By doing so, I believe the new systems can be understood better and operated more efficiently.



First Dual Radio Station

THE operation of two separate radio broadcasting stations on different wave lengths from a single aerial structure is the remarkable achievement accomplished with the opening of the new Radio Broadcast Central at the top of Aeolian Hall, New York City.

The aerial of the dual station is seen in the background in this view from Fifth Avenue and 40th Street over the top of the New York Public Library. Actually it is a double aerial, for the span of wire between the two masts is broken into two separate aerials, simultaneously radiating programs from two studios in the building below on two different wave lengths

How Circuits Are Related

First let us take the well known single circuit regenerative receiver illustrated on this page with its circuit diagram. The layout is very simple—just a couple of coils, a condenser, and a vacuum tube with its accessories. If we take this extremely simple receiver and add to it three fixed condensers and a variable resistance in a certain manner we have immediately the well known Flewelling circuit. Compare the single circuit diagram on this page with the Flewelling circuit diagram on page 58, and you will see at once how closely they are related.

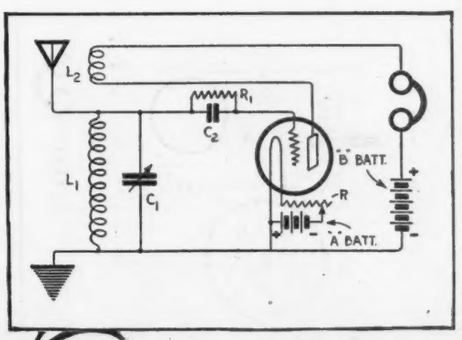
Now let's go a step farther. Suppose, instead of the fixed condensers and resistance we add two large honeycomb coils to this same single circuit regenerative receiver. What happens? Immediately we get the famous Armstrong "flivver," or as it is technically known—the one tube super-regenerative circuit. The Flewelling and super-regenerator look much simpler now, don't they?

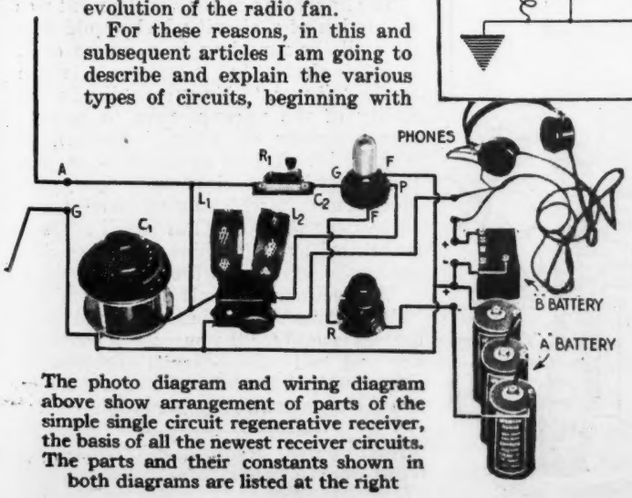
As a matter of fact, the Flewelling and Armstrong circuits are identical in effect. Both perform the same job, but in a slightly different manner. Armstrong, when he produced the super-regenerator receiver used inductances as the main means to obtain the interrupting frequency on which the system is based, while Flewelling later used condensers for the same purpose.

Let us get back to the fundamental system in these three circuits. It consists of using regeneration to amplify the currents which are picked up by the aerial. If we thoroughly digest the idea we will be able to grasp all of the complicated circuits which are based upon it.

Fundamentals of the Circuit

When a signal is received by the aerial, a voltage is impressed across the grid circuit of the vacuum tube. The latter has the characteristic quality of reproducing in its plate circuit an exact duplicate of the current in the grid circuit, but in a greatly amplified manner. What we have in the





The photo diagram and wiring diagram above show arrangement of parts of the simple single circuit regenerative receiver, the basis of all the newest receiver circuits. The parts and their constants shown in both diagrams are listed at the right

A—aerial; G—ground; L—50 turn honeycomb coil acting as primary coil; L_2—75 turn honeycomb coil acting as tickler coil (standard variocoupler can be used instead); C_1—.0005 or .001 mfd. variable condenser (preferably with vernier feature); C_2—.00025 mfd. grid condenser; R—filament rheostat (6 ohms for standard tubes or 30 ohms for new dry cell tube); R_1—variable grid leak, 1 to 5 megohms resistance

plate circuit is high frequency alternating current.

Now if we pass an alternating current through one coil of wire, it will induce a similar current in another coil which is placed in its magnetic field. Consequently, when we take the current flowing in the plate circuit of our vacuum tube, and pass it through the tickler coil of our single circuit receiver, it will feed back energy into the primary coil which is placed across the grid and filament of the vacuum tube. In this case, however, the voltage will be higher, and consequently the amplification greater.

This process goes on until a point is reached beyond which the tube cannot go farther without entering a state of constant oscillation.

Any fan who has operated a regenerative receiver, especially a receiver of the single circuit type, knows that as he moves the rotor coil of his variocoupler slowly the signal grows stronger. Then just when he feels that it is going to be great — blooie! Everything becomes mushy and distorted. What happens is that the regeneration goes beyond its last point of stable operation, forcing the tube into the continuous oscillation state—a condition that will last as long as the batteries connected with the tube have sufficient power in them.

Single Circuit Easy to Master

Operation of a single circuit regenerative receiver is extremely simple. All that is necessary is to find the correct tap on the primary coil of the variocoupler, then do the fine tuning with the variable condenser. Volume is controlled by the rotor coil of the coupler. In other words, there are just two adjustments—the condenser for wave-length, and the rotor for volume.

In describing regeneration action I have dealt with the induction method of regeneration, in other words the electromagnetic action. We can produce the same effect by means of electrostatic coupling, although not so efficiently as with electromagnetic coupling. If we take an ordinary non-regenerative receiver, and connect a variable condenser across the grid and plate terminals of the vacuum tube socket we will get regeneration through electrostatic coupling. I am explaining this because it is necessary to understand it before we can grasp the function of the Flewelling circuit.

As I already have pointed out there is a point in the single circuit regenerative circuit where signals increase in amplification at a great rate, and beyond which the tube begins to oscillate. Here is where we come down to brass tacks in the super-regenerative systems. If we can only prevent the tube from oscillating we can get much higher amplification. That is pretty clear from the way the tube acts. The problem is how to do it.

Major E. H. Armstrong, after many months of experimentation, solved the problem by the simple process of introducing an interrupting frequency. He connected a vacuum tube up in such manner that it was placed into the permanent oscillating state, producing an alternating current of a certain definite frequency. Then he applied this frequency to the regenerative amplifying detector tube of the regular regenerative receiver.

Now this interrupting frequency to a certain extent acts as an automatic switch, turning the regenerative amplifier on and off at a rate corresponding to the frequency of the interruptions, which in general practice is about 20,000 times a second.

Such being the case we now are able to go beyond the point where the signals became mushy before, and to get that greater amplification which was always luring us on in the simple regenerative receiver. The reason we can do it is this: Just as the tube is about to go into permanent oscillation, along comes the interfering frequency and gives it such a violent kick that it has no time to get settled down into a comfortable state of oscillation.

At first Armstrong used a separate tube as the regenerative amplifier, a second tube to produce the interrupting frequency, and a third tube to act as the detector.

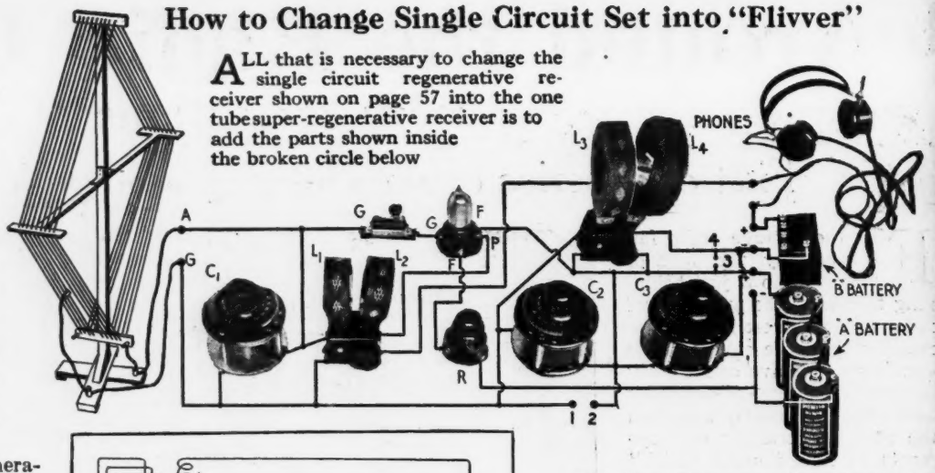
The final stage in the development was the design of a circuit which would produce all the functions in one tube only. It is this circuit that is commonly known as the "flivver." Its success lies in the ability of the vacuum tube to operate simultaneously on different frequencies without interference or inter-action, and this ability is the basis of the various types of reflex circuits which I shall describe in a subsequent article. Thus it will be seen that there is a relationship even between the super-regenerator and the reflex systems.

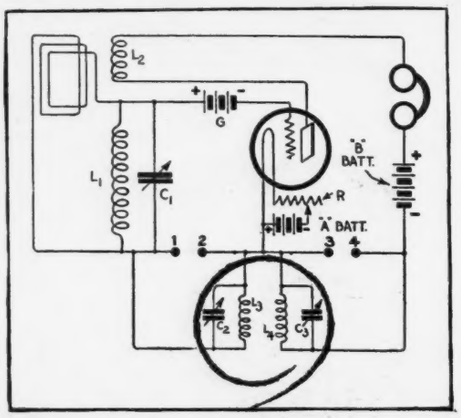
The Flewelling circuit differs from the "Flivver" in that a bank of fixed condensers is used for the purpose of coupling the grid and plate circuits together in order to obtain the interrupting frequency in place of the two large honeycomb coils.

Next month—Radio-audio frequency, reflex and inverse-duplex circuits.

How to Change Single Circuit Set into "Flivver"

ALL that is necessary to change the single circuit regenerative receiver shown on page 57 into the one tube super-regenerative receiver is to add the parts shown inside the broken circle below

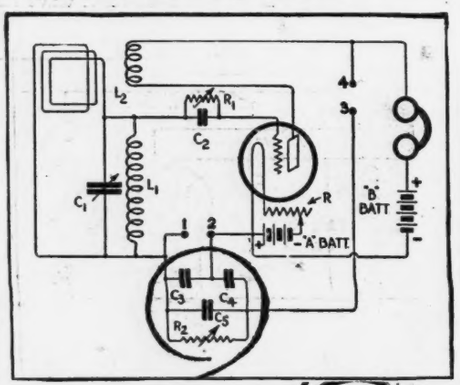




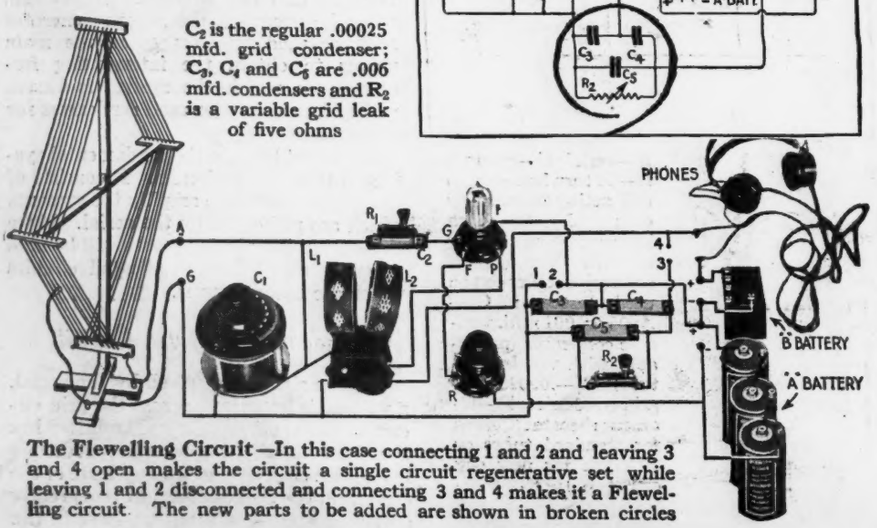
The Super-Regenerative Circuit

In this circuit connecting across 1 and 2, and across 3 and 4 transforms the circuit immediately into a single circuit set. Slightly better results can be obtained if a grid biasing battery shown in the diagram at G is used in place of the grid leak and condenser shown in the photo diagram above. C_2 and C_3 are .0005 mfd. variable condensers; L_3 is a 1250 turn coil and L_4 is a 1500 turn coil

From Single Circuit to a Flewelling Circuit



C_2 is the regular .00025 mfd. grid condenser; C_3, C_4 and C_5 are .006 mfd. condensers and R_2 is a variable grid leak of five ohms



The Flewelling Circuit—In this case connecting 1 and 2 and leaving 3 and 4 open makes the circuit a single circuit regenerative set while leaving 1 and 2 disconnected and connecting 3 and 4 makes it a Flewelling circuit. The new parts to be added are shown in broken circles

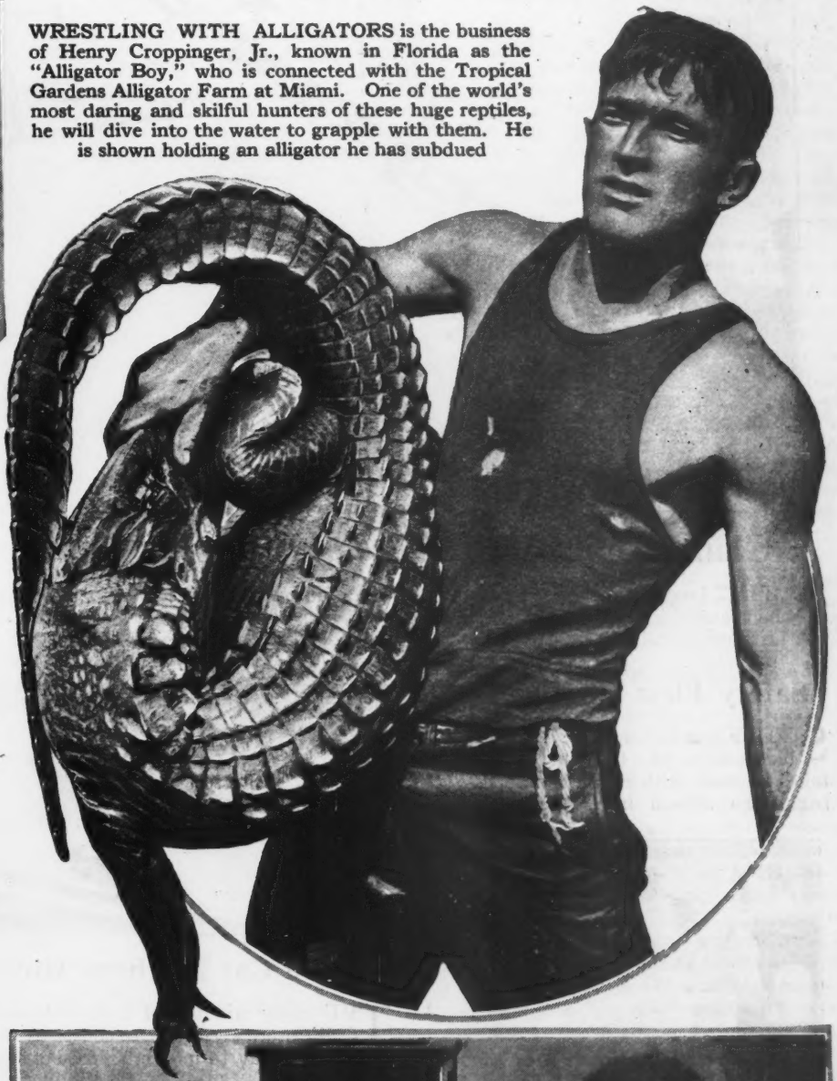
Interesting People and Their Work

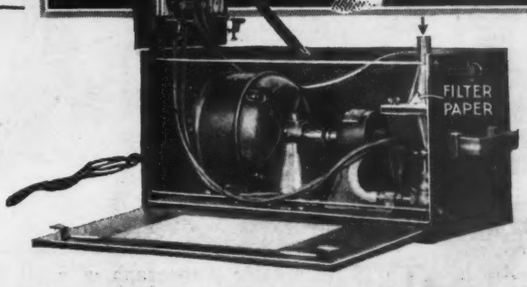
Science Lends a Hand in New Achievements

FROM LOCOMOTIVE ENGINEER TO CONGRESS, is the latest trip of John O. Schafer, of Milwaukee, Wis., youngest member of the next House of Representatives. He goes to Washington as the "Baby" of the lower house, after a term in the Wisconsin legislature

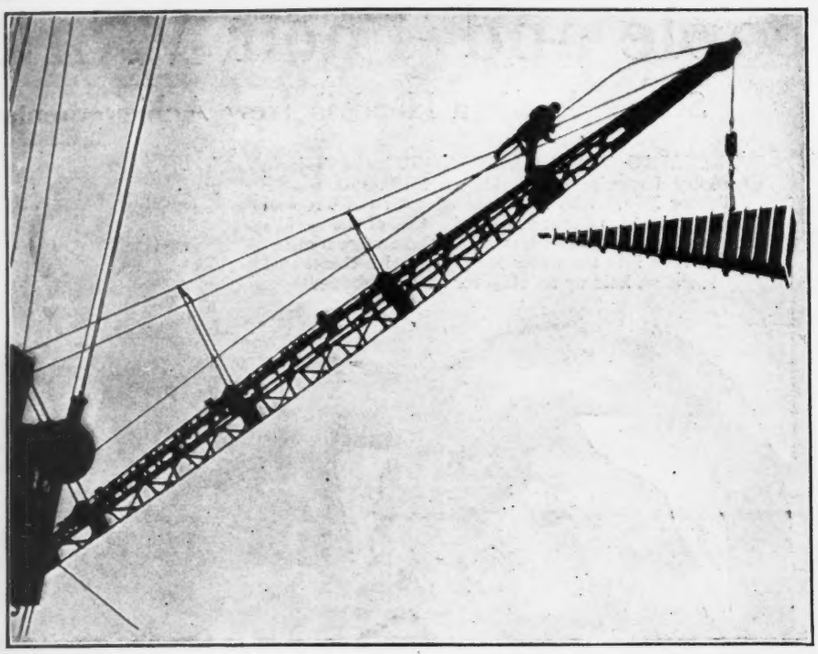
HIS CHEEKS ARE HIS "EYES." Deprived of sight, Carl Bostrom uses the sensitive nerves of his face to "see" his way unaided about the campus of Northwestern University, Chicago. These nerves respond to delicate variations in air pressure caused by buildings and trees. Thus he is able to make a mental map of the campus

WRESTLING WITH ALLIGATORS is the business of Henry Croppinger, Jr., known in Florida as the "Alligator Boy," who is connected with the Tropical Gardens Alligator Farm at Miami. One of the world's most daring and skilful hunters of these huge reptiles, he will dive into the water to grapple with them. He is shown holding an alligator he has subdued





A WOMAN MECHANICAL ENGINEER, Miss Margaret Ingels, of Pittsburg, Pa., recently perfected a new portable machine, at the left, that determines exactly the amount of germ-laden dust in schoolrooms and public places. The device draws air through a chemical filter paper on which dust collects. Amount of dust then is measured by its resistance to the air flow



Giant Loudspeaker Directs Incoming Ships

A GIANT loudspeaker to be used in guiding transatlantic liners into their berths has just been installed at the Southampton docks in England. The photograph shows the monster megaphone in position for throwing voices to incoming ships.

Safety First Horseshoeing

SAFETY first is the rule with this village blacksmith at Goes, Holland, who takes no risks with refractory horses. He backs the animal into the four posted

wooden structure shown in the picture, slips the bolt under its chin, ties the hoof to the diagonal cross piece, and then shoes it in comfort and safety.

Wine Direct from the Wood

AN ENGLISH method of disguising a bottle is to insert it into a knot of wood. The stopper is hollowed from another knot so that when closed the bottle is concealed. Note stopper at the right.

Store Cat Mothers Mice

THE show window of a Los Angeles, Calif., store was the place chosen by Betty, the office cat, to mother a brood of mice.

Ingenious Envelope Sealer Has Rubber Sponge

ON THE tip of this novel envelope sealer is a rubber sponge with which gummed surfaces are moistened for sealing. The sponge is of soft rubber and is pliable like a paint brush. It provides a neater and quicker method of sealing.

Piano Has Double Keyboard

A PIANO with two keyboards, invented by a Hungarian musician, Emanuel Moor, is said to facilitate playing difficult compositions.

The second board has exactly as many keys as the ordinary piano but the corresponding notes are pitched one octave higher. With an ordinary keyboard the pianist often must cross his hands to play notes in the upper register, and he finds that one hand interferes with the other. This is avoided when two keyboards are employed. Either keyboard can be used independently of the other one.

Looking Down from Plane on Billowy Sea of Clouds

THIS remarkable photograph of a billowy sea of clouds was taken 10,000 feet above San Francisco, Calif. The plane shown is testing smoke for skywriting.

Innoculating hay fever sufferers with pollen extracts at the Clinic of Applied Immunology, New York Hospital

Fighting the Hay Fever Sneeze

By William M. Patterson

Chairman of the Executive Committee and former President of the United States Hay Fever Association

MORE than a million persons in the United States at this time of year begin to ask themselves the question: "Is hay fever really curable?"

The summer's welfare of the million depends on the answer to that question. Can they safely remain at home if they wish? Must they try to beat the first sneeze to "immune" resorts? Or must they, for economic reasons, stay at the old grind, suffering the tantalizing agonies that only hay fever patients know?

My answer is not a flat "Yes, hay fever can be cured." If I said that, somebody would be sure to ask me, "Why, then, do you pack up in mid-August and flee to a little island in the Bay of Fundy, where you stay until frost?"

But I will assert that science is fast getting control of this baffling disease which long has been on the "incurable" list. Scientific treatment for it is so far advanced that the hay fever sufferer may look forward now to a summer in his home—city or country — with optimism. In New York City, for instance, hospital records show that the hay fever victim stands a 40 per cent chance of complete relief, and an 86 per cent chance of very appreciable relief.

Before any study becomes far advanced—whether it be psychology or mining engineering—it develops a technique. Science has established a technique in the treatment of hay fever. The generally accepted procedure is hypodermic injection of a solution of the very pollen that causes the disease. There are other means of relief the efficacy of which is vouched for by persons of undoubted integrity. One man I know asserts that wearing red underclothing and a red lining in one's hat has relieved hay fever in cases he has observed. But the pollen solution method is one that has been adopted generally. Its effect, therefore, has been most scientifically observed.

To determine which pollen causes hay fever in an individual, the arm is innoculated with several varieties. The harmful pollen raises an inflamed lump on the scratch

Hay fever is one of the most individual of all ailments. By that I mean, its causes and effects rarely are the same in two people. It might be caused by different things, and its cure requires treatment "made to measure."

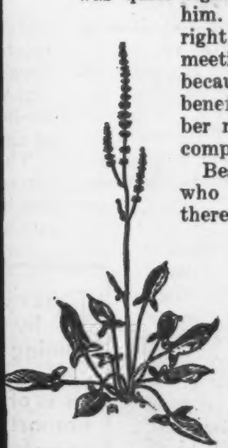
Before physicians had gone far in the study of hay fever, the United States Hay Fever Association had tried to stem the disease in its own way. In its annual conventions in Bethlehem, New Hampshire, members would exchange information on means of relief. One member would get up in meeting and declare positively that wearing tinted goggles would prevent the summer's sneeze. Then another one would rise to say he had tried goggles and they "weren't worth a whoop."

That sort of thing demonstrated the need for scientific research and the establishment of a technique. The first gentleman was quite right—goggles worked well for him. But the second was equally right. However, the convention meetings were—I should say are, because they are still held—beneficial, because a third member might try goggles and find complete relief.

Besides the million and more who are hay fever sufferers, there are, of course, many millions more who are asking, "Will I get hay fever?" In spite of long research, the causes of the disease and the reasons for one's susceptibility to it are not completely known. There are indications that heredity plays an important part. In one investigation, where a number of patients were closely examined, it was found that a third of them had fathers, mothers, sisters or brothers

The picture shows the Russian thistle, an obnoxious weed pest of Middle Western states. Its pollen is one of the causes of hay fever

Flowering top of the common ragweed, arch enemy of hay fever sufferers. Its pollen is extremely light, and is carried five miles by the wind



Another hay fever producer — the sheep sorrel. The light pollen of this weed irritates the nerves of the nose, and causes sneezing

suffering from either hay fever or asthma.

One thing I have noticed—it may sound very unprofessional, but it is the result of years of observation when I was the "big sneeze" of the meetings at Bethlehem—is that hay fever sufferers usually have ruddy complexions. The blood seems very near the surface of the skin.

The disease is impartial to sex. As to age of susceptibility, study of one group revealed the following figures:

With 10 per cent of the patients the onset of hay fever occurred between the ages of 1 and 10; 20 per cent of them contracted it between the ages of 10 and 20; 45 per cent got it between 20 and 30; 20 per cent between 30 and 40, and only 5 per cent contracted it after 40.

Air-borne Pollens Deadly

It is generally agreed among physicians that wind-borne pollens do the damage by irritating the nostrils. One of the most popular traditions about hay fever thus is destroyed—goldenrod doesn't cause the disease, because its pollen is heavier than air. Most hay fever sufferers hate the sight of the flower because the smell of it will cause a tremendous fit of sneezing. But the proximity of fields of goldenrod, or of daisies, honeysuckle or lilies won't induce a lasting attack. Perhaps the offensive ragweed, usually found in such fields of flowers, is the real cause. Ragweed pollen is one of the lightest of pollens, and may be carried easily five miles by an ordinary breeze.

The seasons of hay fever usually coincide with the flowering seasons of various plants. Spring, summer and autumn each bring its own type of hay fever. The prevalent type, known as American hay fever, lasts from August 15 to frost. And each year it arrives nearly on schedule time! I always start for the Grand Central Terminal or the Boston boat within 24 hours of August 15.

But—and this is one of the reasons why science hasn't its thumb squarely on all the causes of the disease—people frequently write to me in February and ask me what to do for a case of hay fever then in progress. This kind of suffering, like certain attacks of asthma, may be traced to "pollen" from a dog, cat or horse.

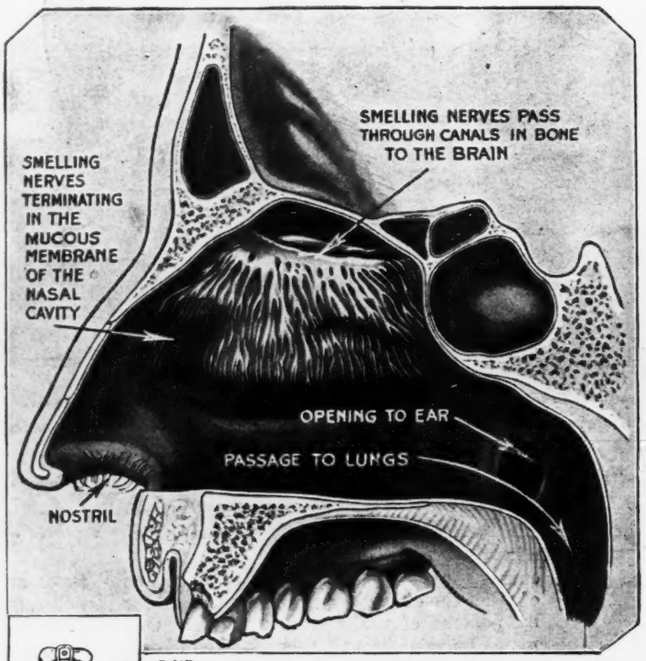
One of the common causes of early spring hay fever is the pollination of trees. Known causes of the various seasonal brands are sage, spiny amaranth, redroot pigweed, Johnson grass, cocklebur, mugwort, rye grass, Bermuda grass, ragweed, June grass, sheep sorrel, yellow dock, redtop, orchard grass, Russian thistle, and, among the trees, cottonwood, black walnut, oak and ash.

Why is it that certain cases fail to respond to treatment? Let me quote part of a letter from Dr. Thomas Howell, superintendent of New York Hospital:

"It occurred to me that you might be interested in the fact that this hospital is conducting special afternoon and evening clinics devoted to the study and treatment of cases of hay fever and allied conditions. . . The efficacy of the remedies and methods employed may be inferred from our table giving the results obtained in a very large number of cases during the past few years. They are subdivided into early hay fever cases and the cases that develop in the latter part of the hay fever season. There are cases which show no improvement whatever and belong to a group in which we have not been able to establish the causative agent. But we are making an extensive study of air-borne pollens of all kinds, in the hope of clarifying these."

The table referred to by Doctor Howell shows that only 4 per cent of the early hay fever cases, and 3 per cent of the late cases, failed to show improvement to treatment. The table follows:

	Early	Late
No symptoms	40%	25%
Satisfactory	46%	54%
Slight benefit	10%	18%
No improvement	4%	3%



How Pollen Causes Sneezing

The nasal cavity, showing the thousands of smelling nerves which terminate in the mucous membrane, the interior coating of the nose. These nerves extend to the surface of the membrane and are exceedingly sensitive. Certain pollens, such as those shown highly magnified at the left, irritate these nerves much as water affects them when it is drawn up through the nose. Nature in attempting to get rid of the irritant causes a convulsive sneeze. This sneezing is a possible symptom of hay fever

Indications are that much investigation remains to be made. It is being done, by private physicians and hospitals in every city. At New York hospital there are two clinics, one in the afternoon twice a week and one in the evening twice a week, for which charges are $10 and $20, respectively. The physicians take no remuneration; the money is used to further the study of the disease. Thus the sufferer whose work or limited means make a trip to an immune locality impossible, may hope for relief at home.

Now as to treatment. Waiting for symptoms is regarded as too late for the best result. The sufferer knows the season at which he is attacked. It is up to him to get treatment beforehand.

A hay fever sufferer is in a state of hypersensitiveness to a definite pollen. This pollen must be determined. Various pollen extracts are scratched on the patient's forearm, much as smallpox vaccine is applied, only less thoroughly. After half an hour or so a white elevation, usually surrounded by an inflamed area, will appear on one or more of the scratches. This is evidence that the patient should be treated with the pollen solution to which he showed sensibility. In case of more than one reaction, the pollen having the greatest effect is chosen for treatment. A dozen or 15 injections should be given beginning six weeks before the start of the hay fever season. The interval between two doses is two days. The patient suffers no discomfort.

In a strict sense, the treatment described is not a cure. No means of making people permanently immune from hay fever has been discovered. While the treatment will make the sufferer immune from the effects of pollen for the season, he will have to go through it all again the next year.

Because cures are not positively assured, the hay fever resort continues to be popular for those who can afford to spend the hay-fever season away from home and work. I go away for the season as I find complete relief and am fortunate enough to be able to arrange my working schedule satisfactorily. One year, when I was serving on a draft board, I had to remain in New York. I took the pollen treatment late in the season because I did not know that until the summer was well along, I'd have to stay in town. The treatment made life bearable, but did not effect the complete relief that would have been possible if I had taken the treatment earlier.

Probably the best known of the hay-fever resorts is Bethlehem, New Hampshire, in the White Mountains, the headquarters of the United States Hay Fever Association. Most people find complete immunity there.

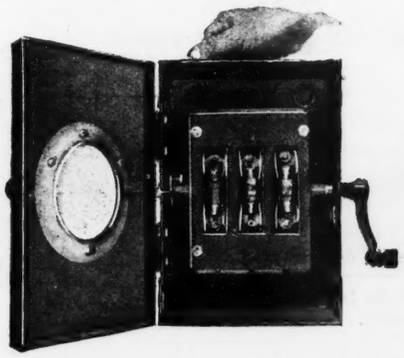
DID you know that pollution of the air by automobile gases actually is becoming a menace to health in our cities?

Recent analysis of air in congested sections of New York City, disclosed that the proportion of deadly carbon monoxide gases from motor car exhausts had increased beyond the point of safety.

An important article in an early issue of Popular Science Monthly will tell what science has discovered about this new menace, and what measures health authorities are proposing to combat it.

Safety Door for Electric Motor Switches

PERFECTED recently by a Chicago firm, this electric switch for motor starting is open for inspection and yet is safe for inexperienced workers. The operation is carried out by means of a crank handle at one side that opens and closes the door and throws the switch off and on. A glass



cover makes it possible to watch the movement and condition of the switch.

When the door is opened by the crank, everything that can be touched by human hand is electrically dead.

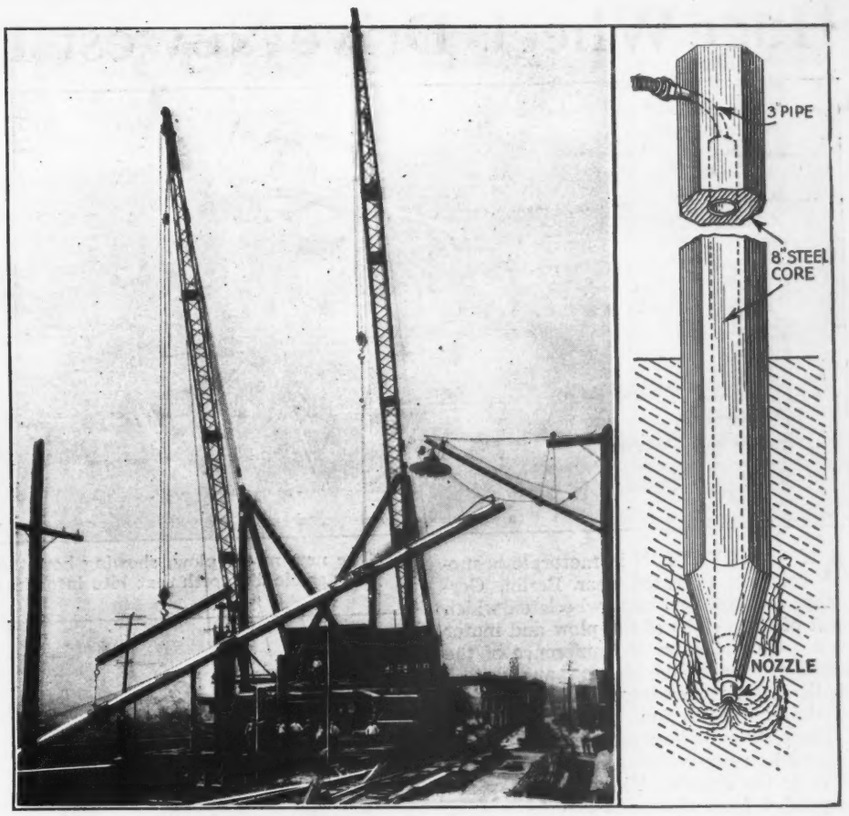
New Safety Stepladder to Reduce Accidents

A SAFETY stepladder that would prevent at least a part of the 20,000 accidents in which ladders figure annually has been sought for a long time by engineers. A concern in Dayton, Ohio, now claims that a new ladder that it is manufacturing will accomplish this result because of its strength and stability.

The frame is made of airplane spruce, and the joints are formed with steel fittings. A railing around the top platform gives a workman confidence. One half of this platform can be removed and fastened a foot higher on the standards.

The wide spread of the standards, besides giving great stability, also permits the ladder to be erected in a machine-filled room, since the ladder can be made to straddle small pieces of stationary machinery and other floor obstructions.

How two safety ladders can be used for scaffolding in a machine shop

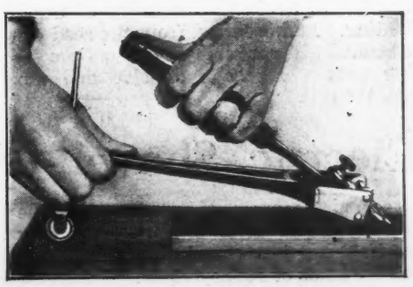


Piles Drive Themselves by Water Pressure

COMPELLED to drive 384 huge concrete piles through nearly 50 feet of muck and mud, engineers constructing a 500 foot bridge over the Ohio canal connecting Akron, O. with Kenmare, a suburb, succeeded in forcing the piles to drive themselves hydraulically through the mud.

The piles, were made octagonal in shape with a hollow core of sheet steel. A three inch pipe was cast through the bulkhead of the pile into the core, and at the lower end of this pipe, in the tapering nose of the pile was placed a nozzle.

A portable crane swings the piles into position to be sunk. When the point of the pile was in place hydraulic pressure of 100 pounds was forced through the core, issuing through the nozzle. This pressure combined with the weight of the pile was sufficient to sink it.



New Tool Sharpens Planes and Chisels Accurately

TO facilitate the sharpening of chisels and planes, a holder that guides the blade as it is moved across the oil stone and thus assures an accurate bevel, has just been invented.

The blade is clamped tightly in the tool and the roller stem in the other end is adjusted at a height which will give the desired angle of bevel. Rocking is prevented and a straight edge assured.

Airplanes May Plant Grain

SOWING grain from an airplane flying over plowed fields has been proposed. From parallel perforated metal tubes extending at intervals from front to back of the lower plane, the seed would be forced by air pressure created by the flight of the plane.

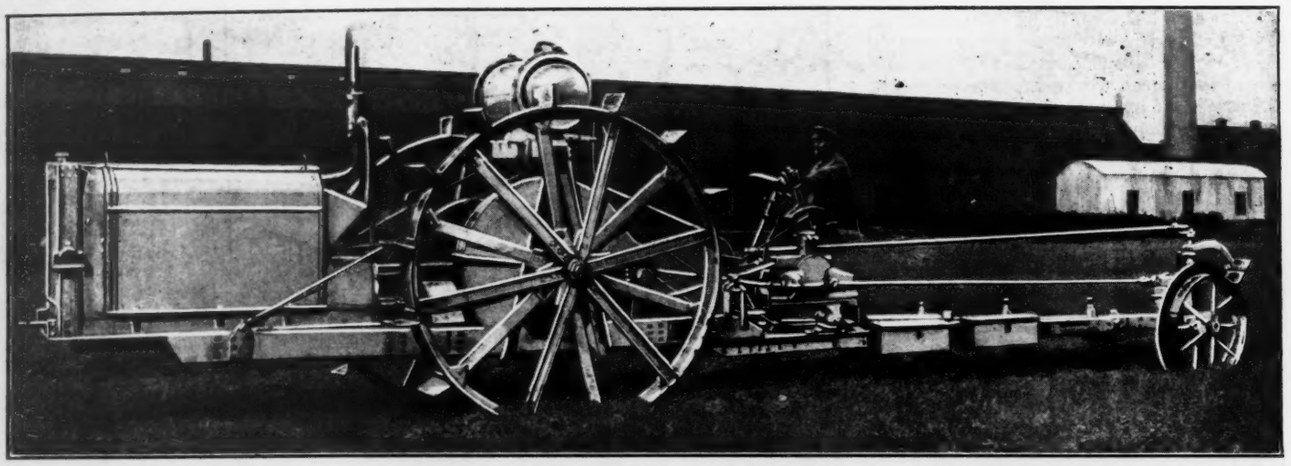
Attachment Turns Piano into an Orchestra

ONE of the recent developments in piano attachments permits a pianist to provide the music of an orchestra.

Twelve tassets extending over as many piano keys actuate xylophone and bells. Cymbals join in the accompaniment and are operated by the foot.

The piano-orchestra, showing bells and cymbals attachment operated by pianist

Huge Wheels Drive Newest Type Motor Plow



The new motor plow, showing how the frame is balanced on huge wheels equipped with spade-like teeth that bite into the ground. Note the rudder wheel at the rear

AN INNOVATION in motorplows successfully operated near Berlin, Germany, employs two huge wheels on which most of the weight of the plow and motor rests. On the outer circumference of the wheels are shovel-like blades that sink to a depth of six inches into the ground, thus obtaining firm traction.

The plow is divided into two main parts balanced on two longitudinal beams which serve as the chassis. The cross beams are suspended from the main driving wheels. On the front part is mounted a four cylinder, 60 horse-power motor, the exhaust pipes rising upward from it. Mounted above the axle of the driving wheels is the large gasoline tank.

The plows are attached under the rear section of the chassis beams, back of the driving wheels, as are also the operator's seat and his controls. The machine is steered by a single wheel at the rear extremity of the frame, back of the plowshares.

The entire weight is so balanced that little of it rests on this wheel which acts as a sort of rudder. Depth to which plowshares turn over the ground is regulated by levers which are controlled by the driver from his seat.

Flower Pots that Dissolve

FLOWER pots that dissolve when placed in moist ground recently have been invented to avoid the necessity of transplanting. Plants forced from the seed can be bedded without removing them from the fiber pots which soon dissolve and mix with the soil.

Foot Pressure Controls New Radiator Valve

SLIGHT pressure of the foot controls a newly invented radiator valve, turning it either on or off. The chief advantage of the valve is that it eliminates the necessity of bending over and turning a dusty valve. It is especially valuable in hospitals because doctors, nurses, and attendants do not need to soil their hands by touching it.

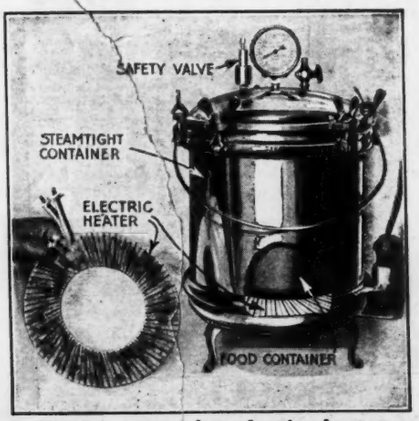
The valve is closed by pressure, and the steam is turned on by pressing a little knob at the upper edge of the valve cylinder.

Electric Cooker Operates by Steam Pressure

EVERY housewife who has stood over a hot kitchen stove cooking a meal in ordinary open pots and pans will appreciate a new electric steam pressure cooker recently put on the market.

An electric heating element, imbedded in the bottom of the cooker gives the necessary heat for generating steam in the container. The cooker is equipped with a plug that can be attached to any lamp socket, and it operates on current of 110 volts.

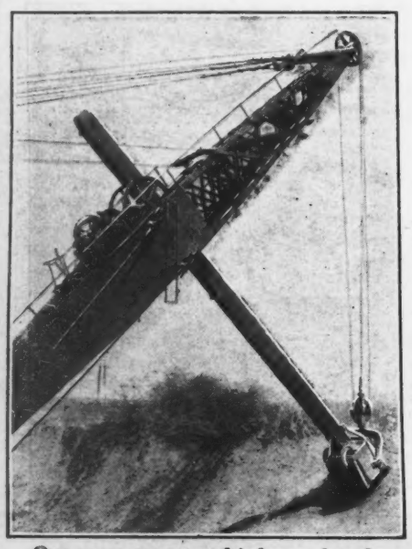
An entire meal, it is claimed, can be cooked with the amount of current ordinarily required to heat an electric flatiron.



The pressure cooker, showing heater

World's Largest Electric Shovel

TWELVE tons of earth with one bite! No, it is not a weird prehistoric monster that has suddenly come to life again. It is a mechanical monster of human make. The world's largest electric shovel, weighing 365 tons, has just gone into action in the iron ore lands of Pennsylvania.



One man operates this huge shovel

It excavates at one scoop as much earth as would fill three five-ton trucks—eight cubic yards. It could carry the entire winter's coal supply of most American families, and in seven bites it could fill the average living room from floor to ceiling. But gigantic as it is, it is absolutely under the control of one man.

Four men could stand abreast in the mouth of its teeth-edged dipper, which is seven feet high. As it eats its way through an embankment, it leaves a vast ditch with sloping sides, 206 feet across the top, 1120 feet across the bottom and 65 feet high—big enough to reach to the fifth floor of the ordinary modern office building. Yet notwithstanding its giant-like power, the huge shovel takes only from 40 to 45 seconds to complete one excavation.

With one hand the operator throws a lever that hoists the boom; with the other he operates a lever that drives the dipper into the bank; and with his feet he works the pedals which swing the boom in one direction or the other.

"Repair It Yourself"

How Any Home Owner, with Ingenuity and a Few Tools, Can Fix Household Electrical Appliances

By Victor H. Todd
Member, American Institute of Electrical Engineers

HOW often have you walked into a friend's home, and pointing to a particularly attractive looking vacuum cleaner, fan or sewing-machine motor, exclaimed, "What a handy thing to have around! You must get a lot of good out of that."

"No," replies the friend sadly, "It doesn't work any more; I guess it's broken or burnt out."

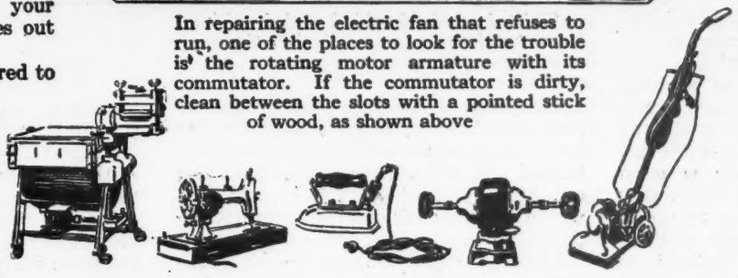
You register astonishment. "Why not have it repaired?" you ask. Then you discover that apparently some one already has passed sentence by saying it would be "cheaper to buy a new one than repair the old one."

Don't let them tell you that about your electrical appliances unless you have lots of money and don't like to tinker. But if you are the average home-lover and are filled with that insatiable curiosity as to what makes the wheels go round, put on an old apron, get out your tools, and steal away to a quiet corner where you may dismantle and reassemble the cripple to your heart's content. Nine times out of ten you can repair it.

Not many tools are required to work with the average electrical apparatus. A large and a small screw-driver, a wireman's cutting plier and perhaps a few small wrenches and files such as may be found in the automobile repair kit are necessary. A small soldering-copper also is very useful.

Every household electrical appliance that spells convenience and comfort can be repaired and kept in good running order at home with little expense, by using a little ingenuity and patience

In repairing the electric fan that refuses to run, one of the places to look for the trouble is the rotating motor armature with its commutator. If the commutator is dirty, clean between the slots with a pointed stick of wood, as shown above



Repairing the Fan

With these tools and the average man's knowledge and love of mechanics you should be able to fix any electrical appliance about the home.

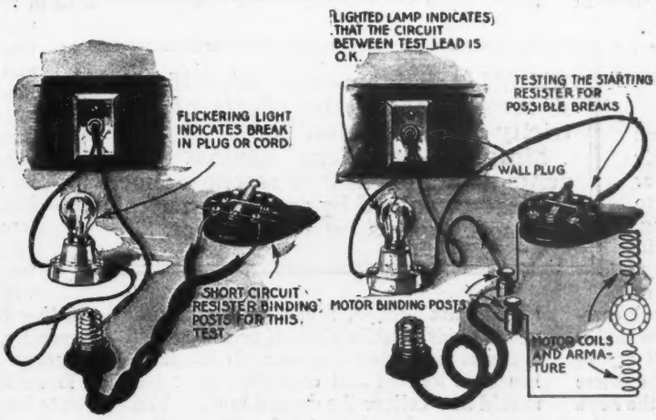
Let us assume that your first job is a fan motor which will not run; which perhaps blew a fuse when last connected. This is the housewife's most frequent complaint and fortunately the most easily remedied by the home tinkerer, since in the majority of cases it lies in the cord and plug.

First fix the electric "juice" so you can tinker without danger of duplicating the "short-circuit" and blowing another fuse. If the repairing is done in the daytime, when the houselights are not in use, the easiest way, in a small house, is to go down to the meter board and look in the main service switch box. In most cases, one line will be grounded; that is, connected to a water pipe with a heavy wire. Now remove the fuse plug in the opposite wire and insert a good electric iron or toaster. If neither of these is available, put in the largest lamp you have, preferably a 200-watt lamp. If the lines are not grounded, put this in either line. Now you may go anywhere in the house and short circuit any socket with immunity from "shorts."

Next examine the cord and plug of the defective apparatus. Here is where most failures occur. Look in the plug top and see that the wires are fastened securely under the screws and that the bare wires cannot possibly touch each other. If the wire or insulation appears worn, cut the wires about an inch from the plug top, skin the ends and fasten in again, using an underwriter's knot (shown on page 66) for twisted wire and ¼ inch tape for reinforced or extra covered cable.

Oftentimes a wire will break inside the insulation and thus "open-circuit" the apparatus. Such a break may be detected by placing the fan motor plug in the socket and short-circuiting the binding posts in the base of the motor with a screw driver or short piece of wire. If the cord is sound, there will be quite a spark. Now work the cord around and bend it back and forth to locate an internal break. If there is a break, it will soon show up by becoming warm.

Another way is to connect a lamp in series; then if there is an internal break the lamp will flicker when the cord is worked back and forth. If the lamp persists in flickering and the break cannot be located, then a new cord obtainable at a few cents a foot should be substituted for the old one.


LIGHTED LAMP INDICATES THAT THE CIRCUIT BETWEEN TEST LEAD IS O.K.
FLICKERING LIGHT INDICATES BREAK IN PLUG OR CORD
TESTING THE STARTING RESISTER FOR POSSIBLE BREAKS
WALL PLUG
SHORT CIRCUIT RESISTER BINDING POSTS FOR THIS TEST
MOTOR BINDING POSTS
MOTOR COILS AND ARMATURE

FOR BROKEN WIRES,
To test the cord of a fan motor for a possible break run two leads from the wall socket to the motor plug, inserting a lamp in series. Then, with a short piece of wire, short circuit the plugs of the starting resister. If there is a break in the wire, the lamp will flicker when the cord is worked back and forth

FOR OPEN CIRCUITS
To find an open circuit touch one lead to one of the motor binding posts, and the second lead, containing a lamp in series, to each connecting plug of the starting resistor successively. If any one of the resistor plugs fails to light the lamp, it indicates that there is a break between that one and the one previously tested

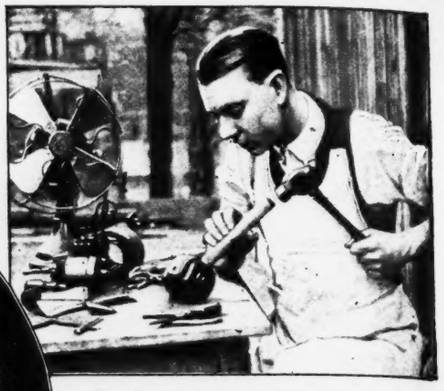
Fixing the Motor

If after making sure the cord is all right and that you have "juice" right up to the motor terminals, the motor still does not run, you must look into the starting switch or the motor winding. First

Repairing the Motor

In searching for a break in the motor winding, gently untape the connections and examine them, as shown below. Breaks usually are found in soldered connections or loose ends

In an alternating current motor is found a set of little centrifugal fingers that fly out when the motor is running. Sometimes these fingers stick and remain out, when the motor stops. Examine them to see that they work freely



If the rotating armature of the motor sticks, free it by tapping the end of the housings to line up the bearings, which may have become damaged by a fall. If necessary, remove the end bell and look for foreign matter such as dirt and lint

note whether the fan blades turn freely, or whether they tend to bind or stick. If the fan is of the oscillating type, the oscillating mechanism may be disconnected until the motor is running. If the rotating armature sticks, free it by tapping the end of the housings to line up the bearings which may have become damaged due to a fall. If necessary remove the end bell and look for foreign matter such as dirt, hair, and lint.

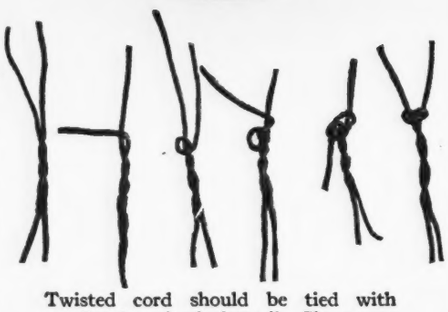
Now, spinning the blades freely by hand, insert the plug in the socket, being sure that at least a 200 watt lamp or 500 watt iron is in the circuit. One of four things may happen:

The fan may run; it may buzz, but not run; it may run jerkily; or it may stand still.

If it runs, your job probably is finished, except a little oiling and cleaning up. If it buzzes but fails to run the trouble may be merely mechanical sticking or rubbing, which can be eliminated quickly. If this is not the cause, the principle of the motor's operation is the first thing to determine. In alternating current motors is often found a set of little centrifugal fingers that fly out when the motor is up to speed. Sometimes these fingers remain sticking out, instead of returning to their places when the motor stops. Examine the end of the armature and see that they work in and out freely. See also that they make good contact on the central split-bell which they short-circuit when the motor starts. Also test the armature winding for open circuit, the same as was done with the cord and plug, preferably replacing the big lamp or iron temporarily with a 15 or 25 watt lamp. Tap the test leads to the terminals of the starting winding. If the winding is intact the lamp will light, but not to its full brilliancy.

If the motor has two windings which are in circuit all the time, look carefully for breaks in the wire. If the motor previously has run all right, don't try to change connections and move the wires from one connection to another in the hope that this will make it run. You may be fairly certain that a break, not a changed connection, caused the motor to stop. In searching for the break, first gently untape the connections and see that they are good. Breaks seldom occur in the winding itself; usually they occur in soldered connections or loose ends.

Perhaps the motor has two field coils, with a commutator on the armature, and two little carbon brushes. See that the brush springs have not lost their springiness from over-heating, and that the brushes touch firmly on the commutator. If this is burned and dirty, clean it well with fine sandpaper (preferably in a lathe) and then with a pointed stick of wood clean out the dirt between the slots, being very careful not to break any of the very fine wires connecting with the commutator bars. Examine these wires closely to see that none already are broken, removing the thread which binds them in place, if necessary.



Twisted cord should be tied with an "underwriter's knot." Six stages in tieing this knot are shown above

Again assemble the motor. If the fault has been located and corrected, your fan should now deliver the desired breeze. The grease cups should be filled with vaseline and the bearings oiled.

Jerky running usually is caused by an open circuit in the armature, the failure of a brush to touch, or a loose connection. The actual point of failure usually is detected by a vivid spark.

If after all this experimenting, the motor shows no signs of life, the failure undoubtedly is due to an open circuit. To locate this, make a sketch of the complete circuit, resolving it into a single circuit. Then having ascertained that the cord and plug are in good condition, and the "juice" is turned on, first touch one lead to one of the motor binding posts and the second lead to a connecting plug on the resister. If the test lamp lights, then the circuit is good so far; if it doesn't light, then the "open" is between these two points. Perhaps the rheostat arm doesn't touch or there is an "open" in the starting rheostat.

If this section of the circuit is good, then touch the second lead to the remaining plugs of the resister successively. If they all light, you will know there is nothing wrong with the circuit. But suppose one of the plugs fails to light. You will know immediately that there is an open circuit in the apparently solid wire connecting that plug with the one previously tested. The wire should be replaced by a new one. The location of electric faults in sweeping motors usually is easier than in fan motors as practically all sweepers employ a small commutator type motor without a starter. If the sweeper or sewing machine fails to run, or even buzz, when connected first make sure that you have a good cord and plug. Then look at the brushes, see that the armature turns freely, and test for opens.

Sweeper motors require more mechanical skill in repairing than do sewing machine motors. In dismantling do not rush the work. Study the construction and find out just what each part holds. When removing screws and nuts, remember where they came from. Time spent in studying and remembering during dismantling will be repaid tenfold during reassembling. Above all, don't attempt to force the parts by hammering or filing. Remember they weren't put together that way. Parts that once worked freely seldom require filing or refitting to make them work freely again. Generally, they are already too small, due to wear.

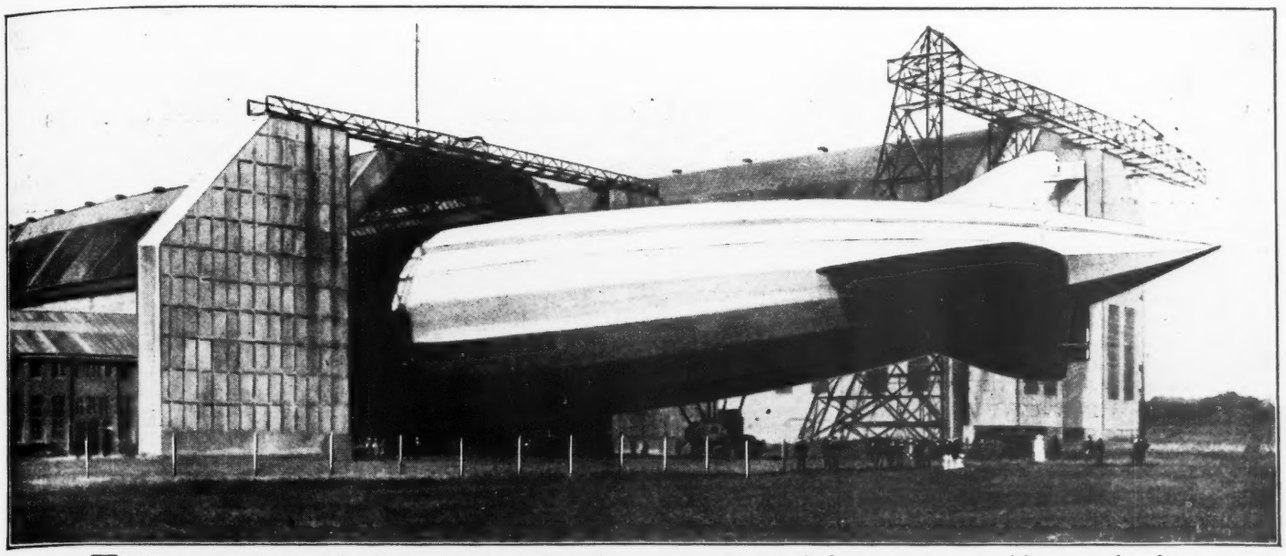
In suction sweepers the trouble often is due to bent fan blades which have hit tacks or nails. These blades may be straightened by bending or hammering. Clean out all dirt and hair from around the motor bearings, as this causes unnecessary friction. Use a good grade of oil, and use it liberally.

But remember, before calling a repair man, try to locate the actual fault yourself first. The chances are that with a little patience and ingenuity you may be able to save yourself many dollars in salvaging your household electrical apparatus.

IN AN early issue—new scientific discoveries about the effects of electricity on the human body.

Simple precautions against accidents at home—how to rescue a shock victim—explained by one of America's foremost experts on the subject.

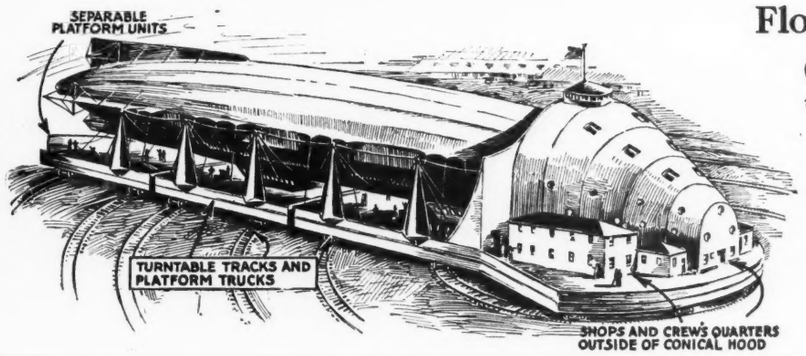
New U. S. Zeppelin to Cross Atlantic

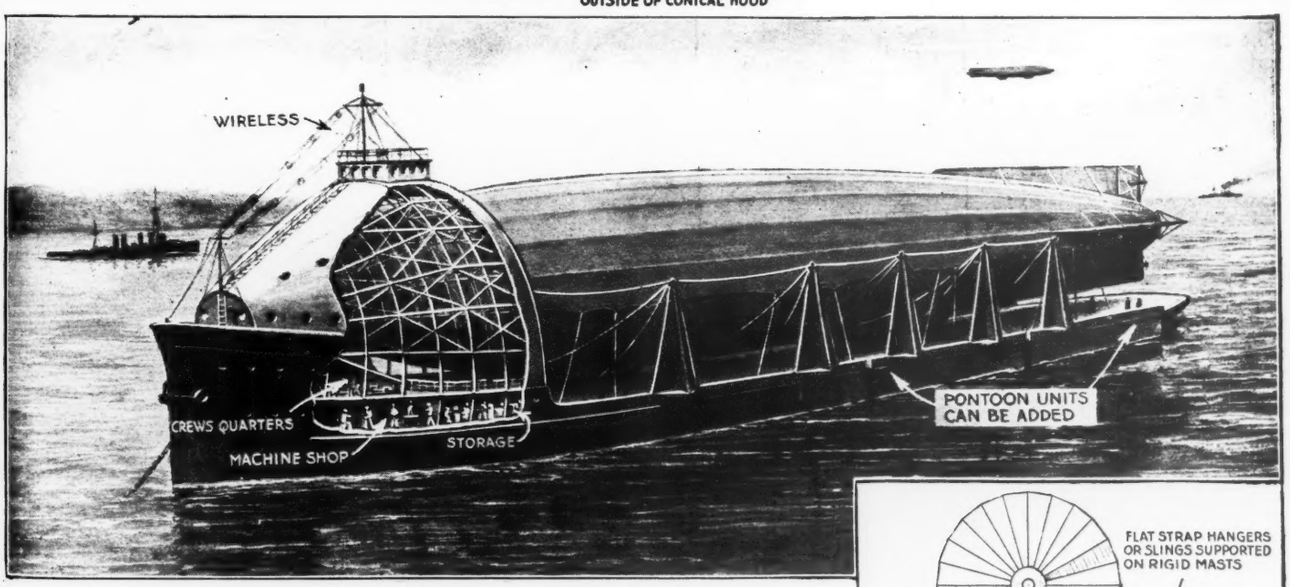


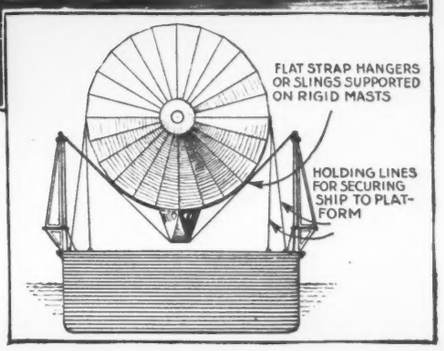
THIS recent photograph shows the giant Zeppelin ZR-III, nearing completion at Friedrichshafen on the Lake of Constance, Germany, for early delivery to Uncle Sam in accordance with the reparations agreement. On its trip to the United States it will be manned by a German crew. Aeronautical experts are awaiting eagerly the opportunity to compare its performance with that of the great airship ZR-I, now nearing completion at Lakehurst, N. J. Note the immense size of the ZR-III, as compared with the spectators on the ground underneath

Floating Hangar for Airships

ONE of the most ingenious of recent proposals for mooring airships is the invention, by John Mason of Cape May City, N. J., of a floating hangar and landing field adapted for use on either land or water. Its chief advantage lies in the fact that it swings head to the wind, thus reducing wind interference in landing a dirigible safely. The illustration at the left shows the land hangar and how it swings about on turntable tracks. It is divided into three sections with separable platform units. The main or head section has a conical hood in which the nose of the airship is anchored







ADAPTED for water use, the landing hangar rests on pontoons. The head section, with its conical hood, ends in a pointed bow like that of a ship. Anchored at the bow, the entire structure naturally swings head into the wind.

The diagram at the right shows how the airship is moored. On each side of the platform deck formed by the pontoon sections is a series of masts. Between opposite masts flat, flexible slings are suspended, passing under the hull of the airship in the form of a cradle. The airship is held fast in this cradle by cables extending vertically from the sides of the hull to mooring rings on the platform deck. A wireless station is mounted at the top of the conical hood

Court Summons Padlocked to Car

A PADLOCK containing a police court summons, when locked on the automobile of the Seattle speed violator marks the car until he reports in court to pay his fine and have the lock removed.

The lock was invented by three Seattle policemen to eliminate the trouble caused by offenders who fail to report.

Alarm Flashes Warning of Low Oil

A DASHBOARD alarm that signals "Low Oil" recently has been perfected by a manufacturing concern in Elgin, Ill., to provide automobilists with a means of discovering instantly when the oil pump is not working properly.

The device consists of a metal bulb in the center of which is a diaphragm. Oil from the pump is led through a tube to the lower chamber of the bulb where it presses upon the diaphragm and causes two electrical contacts to remain separated. Thus, as long as there is sufficient oil in the engine and the proper pressure is maintained, the light will be inoperative. When the oil becomes too thin the points are brought together by the lowering of the disk. The contact of the points dimly lights a red light located on the dashboard. If the engine runs dry the light burns very brightly to warn the driver.

This appliance can be used only where the engine is equipped with an oil pump, and is therefore not adaptable to trucks with engines oiled by the splash system.

Construction of this "low oil" signal device is shown in diagram. Low oil pressure permits two electric contacts to meet, lighting a red lamp on the dashboard of the auto

Fuel from Gas, Water, Oil and Air

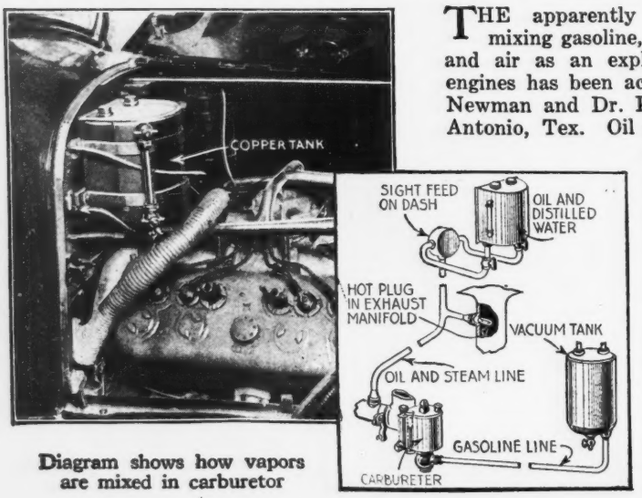


Diagram shows how vapors are mixed in carburetor

THE apparently impossible feat of mixing gasoline, water, lubricating oil and air as an explosive for automobile engines has been accomplished by M. A. Newman and Dr. K. A. Mayers, of San Antonio, Tex. Oil and water are kept in separate compartments of a tank under the hood. Separate pipes lead these fluids to a sight feed where they join and flow to a hot plug in the exhaust manifold. Here the water is transformed to superheated steam and the oil is atomized. The vapors then are conducted to the carburetor where they mix with gasoline and air mixtures.

Handy Auto Wrench Fits Ten Sizes of Nuts

EVERY man who uses tools around the home or automobile will appreciate a handy new practical wrench that is cast in one piece and has openings to fit 10 different sizes of nuts.

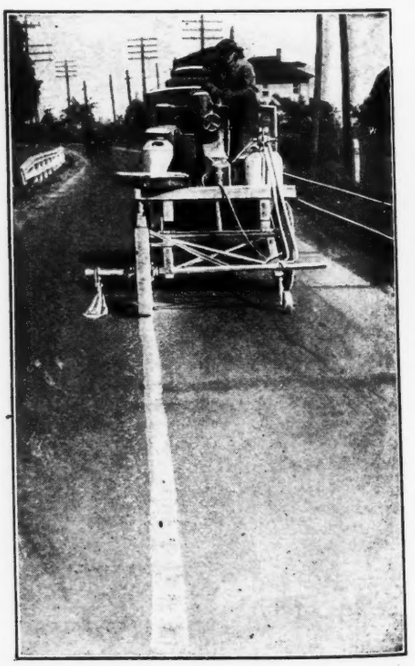
It has no moving parts to be adjusted or to get out of order, and does not slip or spread as do other types.

Thorny Puncture Vine Is Death to Tires

BEWARE of your tires while going through the Imperial Valley of California. The puncture vine, otherwise known as "tribulous terristis," meaning earthly trouble, has migrated from the edge of the Sahara Desert to the valleys of California, where it lies close to the ground waiting to puncture slightly-worn automobile tires. Thorny seed-pods, called calthrops stick up from the spreading vine.

Highway Division Lines Painted by Machine

WIDESPREAD use of painted lines to divide highways in order to keep motorists on the proper side of the road has led recently to the construction of a road

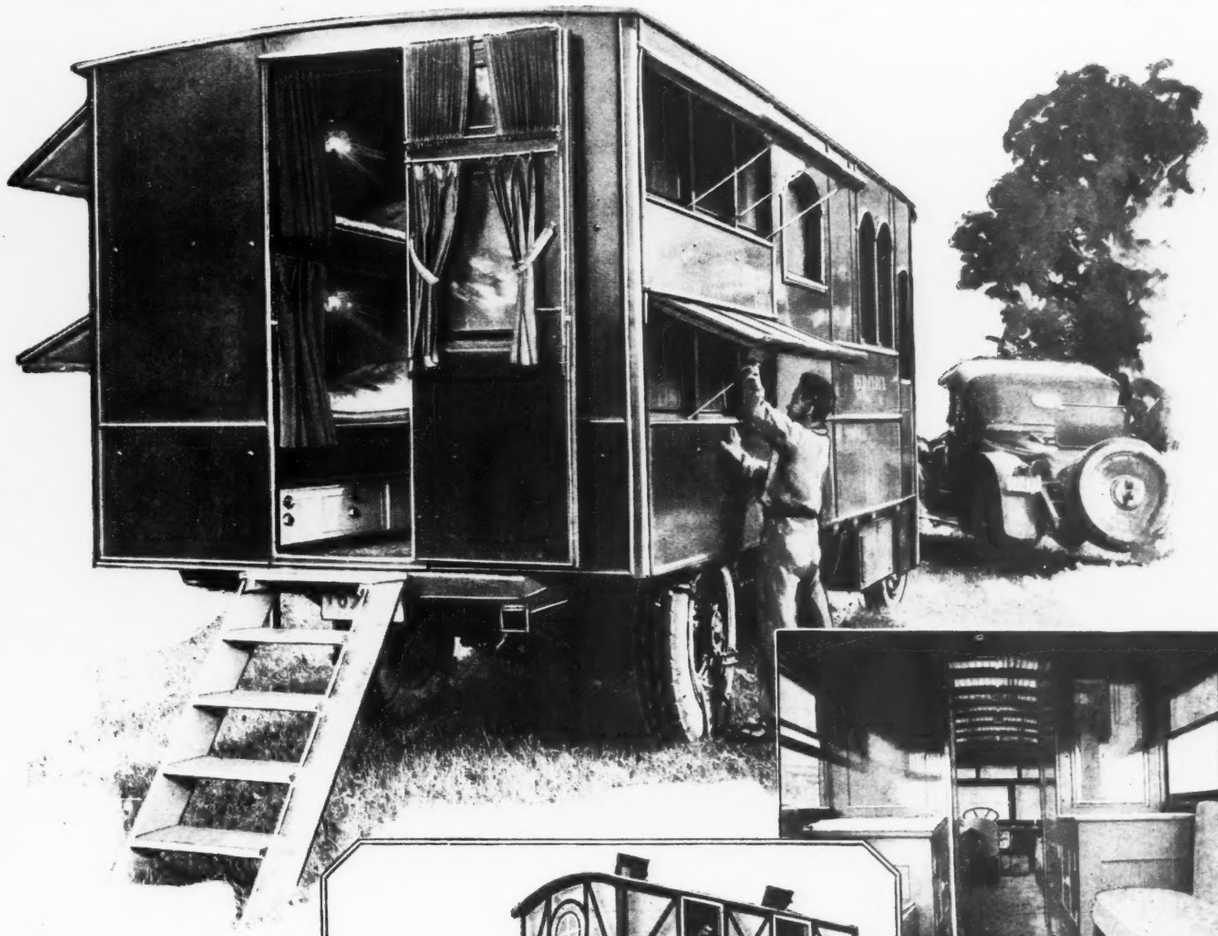


painting machine mounted on a motor truck.

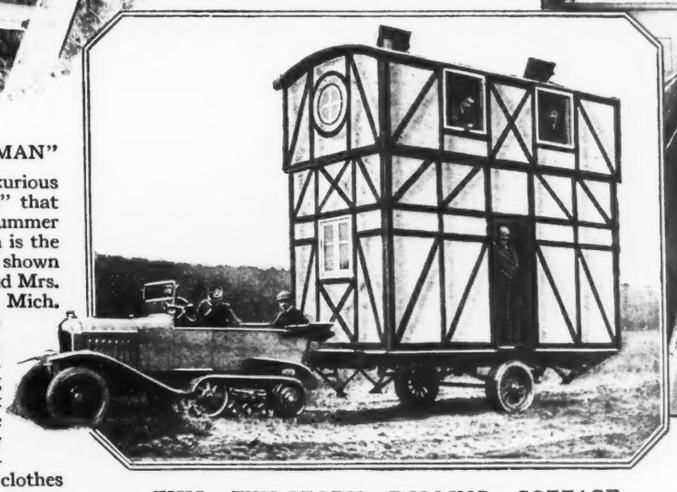
Paint, played upon a felt tread by compressed air, is transmitted to the pavement by a trailing wheel. White paint is used so as to obtain a sharper contrast with the oil soaked pavement.

Luxury in Summer Motor Caravans

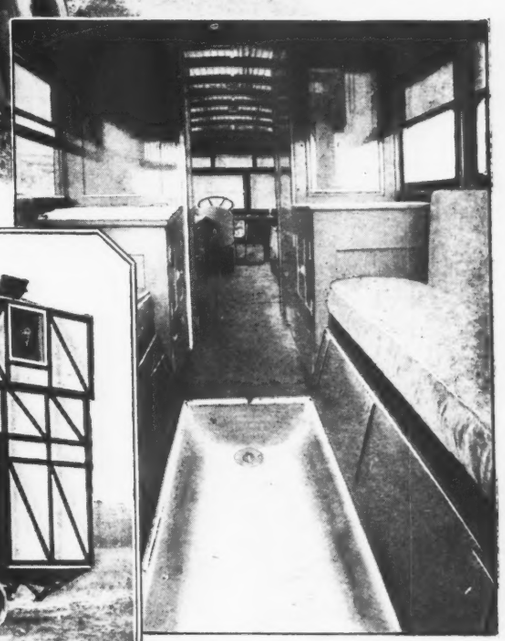
"Pullman" Car and "Steam Yacht" Are 1923 Novelties of the Open Road



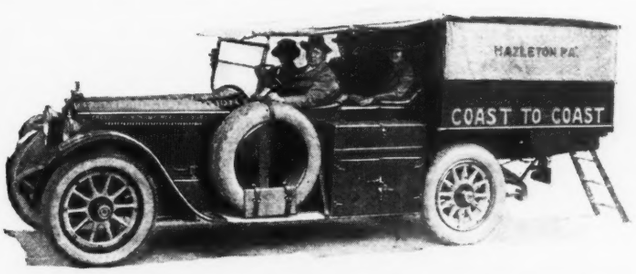
MOTOR CAR "PULLMAN" TYPICAL of the luxurious "cottages on wheels" that have joined the annual summer motor caravan this season is the "Pullman" motor car shown above, designed by Mr. and Mrs. C. F. Rouze, of Pontiac, Mich. Its interior is divided into two large compartments, each of which is converted at night into a sleeping room with double-deck folding beds that become cushioned seats in the day time. Between compartments is a toilet and large clothes locker. The front compartment is the kitchen, equipped with stove, sink with running water and refrigerator. The car is equipped with electric lights and the windows are securely screened



THIS TWO-STORY ROLLING COTTAGE mounted on a two-wheeled trailer, is hauled by an unusual automobile-tractor equipped with endless treads in place of rear wheels. These treads make it possible to traverse the roughest country. This type of French car recently crossed the Sahara desert



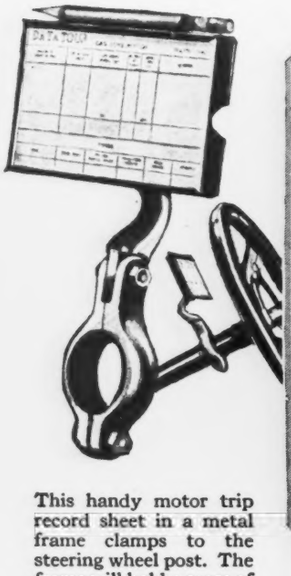
Above is shown the four-foot white enameled bath tub under the floor in the rear compartment of the Rouze "Pullman" motor car. The floor swings back on hinges. The tub is supplied with running water under air pressure, from a 30-gallon tank



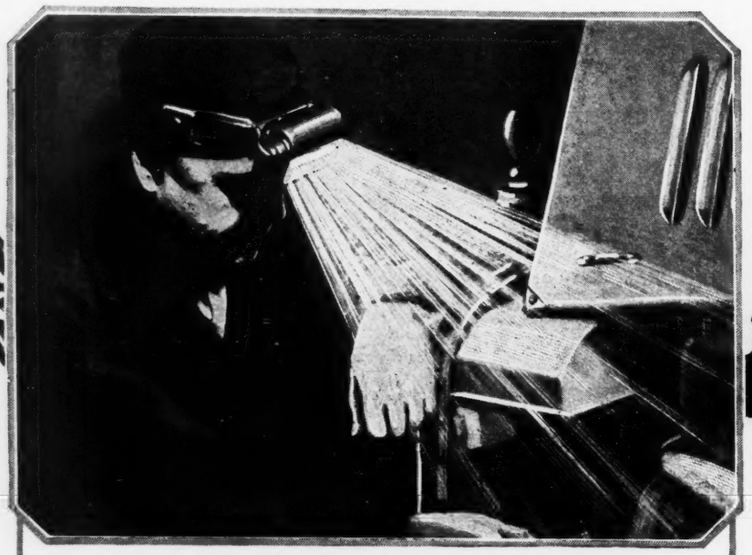
EIGHT MONTHS IN THE OPEN have not dampened the ardor of G. Stuart Engle and his family of Hazleton, Pa., who have covered 10,000 miles of the United States traveling from coast to coast in this "covered wagon"

THE FIRST LAND-GOING STEAM YACHT made its appearance this season in a journey into the Great American Desert of Southern California. C. S. Abbott, of Jamestown, N. Y., is captain and owner. Note wireless antennae

Useful New Aids for Auto Owners



This handy motor trip record sheet in a metal frame clamps to the steering wheel post. The frame will hold a score of record cards. Note the pencil holder attached

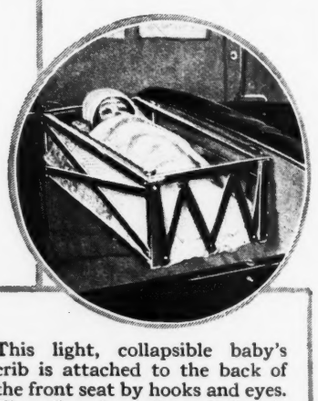


An aid to auto owners and mechanics is a portable safety lamp consisting of a small reflector containing two six-candlepower electric bulbs. An adjustable strap holds reflector to the mechanic's head

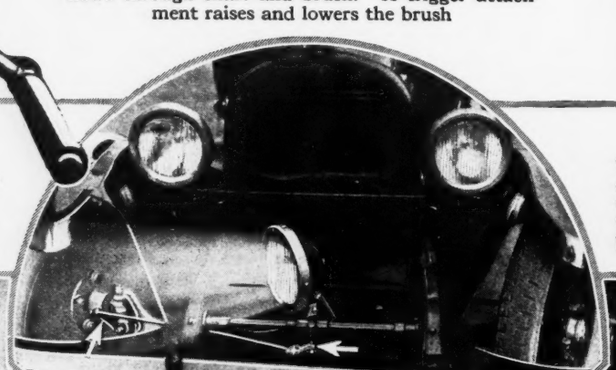
Attached to a driving glove, this signalling device contains two electric flash lamps wired to contacts on thumb and index finger. Pinching contacts together, closes circuit and lights lamps

For the car owner who dreads the weekly washing, a Frenchman has invented this combination brush and spray. Water enters through the handle and flows through shaft and brush. A trigger attachment raises and lowers the brush

Freedom from danger of a broken arm in cranking a Ford is assured by this non-kick ratchet and pawl device that disengages the clutch when engine backfires



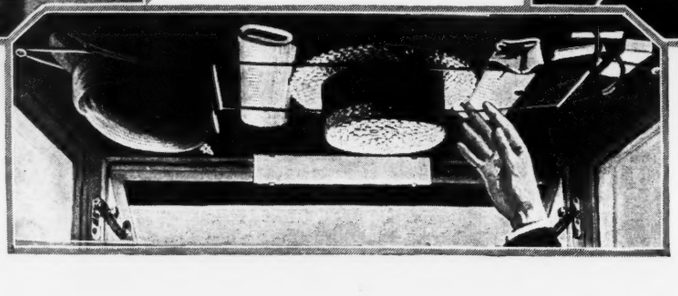
This light, collapsible baby's crib is attached to the back of the front seat by hooks and eyes. The crib ends are formed of angle bars that permit folding of crib



An automatic headlight that lights the road in the direction the car is turning, is connected with the steering wheel in such a way that a turn of the wheel instantly turns the lamp in the same direction

Leather strips drawn up taut by adjustable bars form a light weight hat holder for the auto top, as shown below. The convenient holder will not sag, rust nor rattle

Here is a new glareless auto headlight and its inventor, R. C. Gowdy, Professor of Physics at the University of Cincinnati. Glaring is prevented by fluting the parabolic reflector so that the light is distributed properly

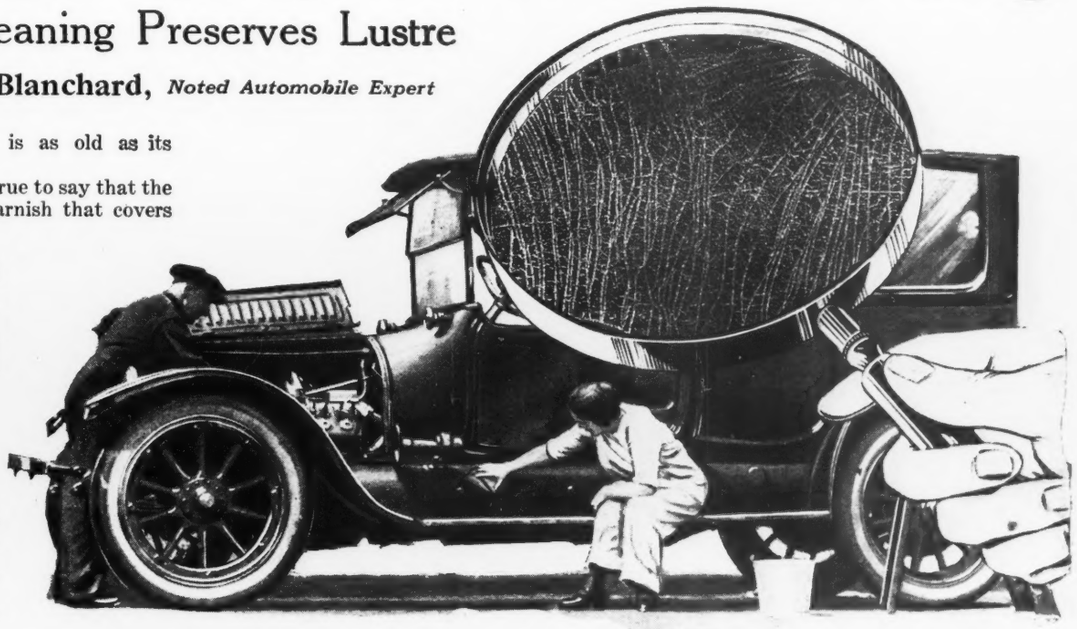


A new type of auto lock, attached to the post, contains two plungers that firmly hold a spoke of the steering wheel between them when the device is locked. Turning of a key releases the plungers and unlocks car

How to Keep Your Car Young

Scientific Cleaning Preserves Lustre

By Harold F. Blanchard, *Noted Automobile Expert*



Under the magnifying glass is an actual sample of abused automobile finish, eaten and scratched by mud, sand, grease and soap. It may be prevented by scientific washing of the car with a gentle stream of clean, cool water, followed by a light sponging, as shown in the photograph above

AN AUTOMOBILE is as old as its paint.

And it is just as true to say that the paint is as old as the varnish that covers and protects it.

That new car of yours—how it glistens and sparkles out there in the driveway. How long will that lustre and beauty remain to thrill you?

The minute you start the engine for the first spin over the roads you are embarking on an endless warfare with the enemies of car beauty and youth. In the vanguard of these enemies are mud and dust. Following them in quick order come oil, grease, muddy water, road tar, soap, hot water, gasoline, kerosene, and even some kinds of polishes.

What are you going to do about it? Either you can stand by and watch the new car grow old before its time; or you can roll up your sleeves, turn on the water, and fight the battle in defense of glossy finish that will make your machine an almost endless source of pride.

I have in mind a car that one of my acquaintances recently purchased fresh from the factory. It is just two weeks old. Yet its poor abused body, wrinkled and cracked with age, looks as if hob nailed dancers had been doing the marathon over its once-polished sides.

Well Groomed after Ten Years

On the other hand there is another car I have observed on the streets of New York City year after year. It is 10 years old; yet it looks almost as splendid as the day it appeared. Wherever it stands at the curb it attracts a crowd of admirers. The secret?

Artistically correct lines to begin with, plus scrupulous care of the finish. That is the secret of car youth.

To keep away the telltale cracks and lines of old age—sure signs of abuse or neglect of the varnished finish—the safest way is to assume that everything is harmful to varnish. As soon as varnish comes in contact with any foreign matter it begins to deteriorate.

Mud draws the varnish—literally eats it. If mud is allowed to stand on the finish for two or three days, it leaves permanent marks. Muddy water and dust do the same kind of damage. In addition, mud and dust have a grinding action that scratches and wears away the polished surface. That's why you should never dust the surface nor wipe off mud.

Oil, grease, road tar, gasoline, kerosene and soap produce a chemical action that gnaws into the finish, while a splash of alcohol from the radiator will dissolve any varnish it touches.

Next to mud, soap probably is the car's worst enemy; yet I believe that not one in a thousand cars is kept free from it. To the average auto owner a bar of laundry soap and a scrub brush would seem the quickest and easiest way to remove mud and grease. They are the quickest—in ruining the finished surface.

NEXT month—How to Buy a Car. Expert advice from Mr. Blanchard that will prove helpful to every prospective purchaser of an automobile.

There is just one best way of removing mud, dust and grime—that is to rinse it off with a gentle stream of clean, cool water. Yet even clean water may be harmful under certain circumstances. The car never should be washed in bright sunshine. Rapid drying of the water by the sun will cause streaks in the finish. Yet very cold water applied during cold weather also is injurious.

The actual washing of the car should require not more than a few minutes. Before you begin have your equipment ready—rubber boots, two sponges, two pieces of chamois, a pail, a hose already connected, some fine neutral soap already dissolved (for the running gear), a whisk broom, a brush and finally, a barrel of water. One chamois and one sponge are for the body; the others for the running gear. Be sure not to mix them.

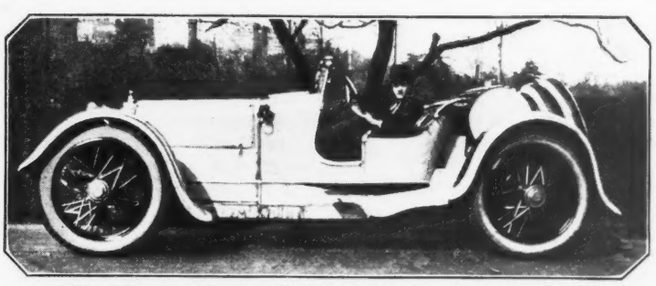
First clean the top and interior with the whisk broom. Next, clean all glass windows with a good scouring soap. Now soak off all mud and dirt from the body with a gentle stream of water from the hose (never use a nozzle). When you have done this, dip a pail full of water from the barrel and proceed to sponge the body systematically with water from this pail. Be sure to keep clean water in the pail. Use plenty of water on the sponge and no "elbow grease." Wipe the body of the car dry with chamois. Wet the chamois thoroughly and wring it dry before using it.

Cleaning the Running Gear

The running gear comes next. Wash off loose dirt and grease with the hose, then sponge the gear thoroughly. At this stage soap can be used in the water without harm. Finally, rinse off the running gear with the hose to remove any trace of soap, and dry with the chamois.

If the body of the car has lost much of its original gloss, then and then only is it advisable to use polish. Be sure the polish is of good grade, otherwise it may do more harm than good. In polishing nickeled parts beware of abrasives that will wear down the nickel coating and expose the brass beneath. Use only the finest of silver polish and a soft flannel cloth. It is a good plan to wipe the trimmings each night.

By following these few simple rules you will find new pleasure and pride in ownership. Remember always that your car is just as fine a possession as a mahogany grand piano—and you wouldn't scrub your piano with laundry soap and a brush!



This 10-year-old car still looks like a well groomed old gentleman, just because its New York owner has preserved its finish carefully by scientific methods of cleaning

Building a Profitable Jobbing Business

By H. L. Wheeler
Machine Shop Foreman

MANY capable, all round machinists look forward to establishing a small jobbing business of their own. Mechanical ability alone does not, however, insure success in such an undertaking.

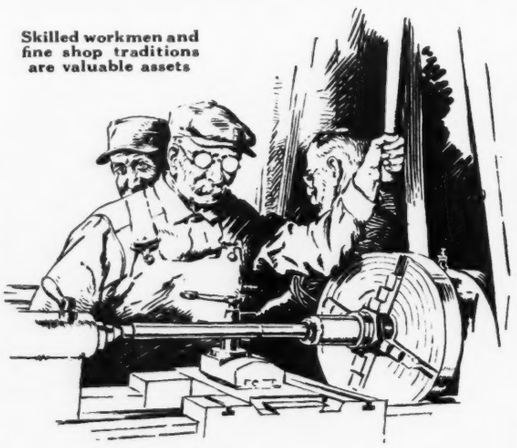
It is safe to say, I think, that 75 per cent of small jobbing shop owners try to grasp all the business in sight and are constantly seeking to add new accounts. When business in general is brisk this frequently tempts shop owners to over extend themselves.

If you are running a small shop, you probably are asking yourself at this time, "What is the best way to take advantage of my present chance to expand?"

You are trying to make your shop bigger. In the course of six months or a year you have increased the volume of your business from, perhaps, $25,000 to $50,000 or more. You consult a firm of efficiency engineers and perhaps are persuaded to install a new system, and up goes your overhead.

Right here I suggest that you quit trying to make your shop bigger and devote your energy to making it better. Your shop, let us assume, has traditions. It was founded back in the sixties; it has been in the same family for two or three generations; it is well situated; it has done business for many years with the same concerns and individuals, and there are still two or three men who worked for your father.

These traditions are capital not easily figured in dollars and cents, and should be jealously guarded.



Skilled workmen and fine shop traditions are valuable assets

The growth of large shops is by no means a sign that small shops are doomed. Small towns are still vastly in the majority and in a day's journey it is not hard to find many small shops that do a thriving business.

A small shop can make more money with the minimum equipment by handling small work. Large work requires expensive, heavy equipment that often is idle. A shop that specializes in small work avoids these heavy losses and also loses less through bad accounts. There is also less competition in small work, and rarely does a customer ask that a hard and fast price be fixed unless the job happens to call for large lots of small parts.

Hazards in Large Contracts

In the case of large work, like the overhauling of power plant machinery, the customer is apt to shop around for a price. If one of the shops figures low, perhaps through error, it is very apt to get the job.

I recall one instance when two young partners were much overjoyed when they received a contract for machine work for the city fire department, but they were so low in their estimate and overreached themselves so far in attempting the work that at the end of several months they could not meet their bills and had to quit.

Spoilage and waste are also much greater on large jobs. If the shop foreman tells you that someone has made a "bull" on a big job, it is a serious and often costly matter.

Another thing the small shop owner can turn to his advantage is the fact that many buyers of machine shop service are reluctant to take small jobs to big shops.

The small shop can sell service the same as any other product. Customers appreciate it and ordinarily are quite willing to pay for it.

Service in this sense means keeping promises and making deliveries on time. If you tell a customer that he can have a job at 4 o'clock that afternoon, make it a point to give it to him. If your customer brings a job that you can see at a glance is too large for your shop, tell him so, or that your shop is specializing in small work. You may be able to refer him to some other shop that can do the job more economically. If you show him how he can save some money, you will have made a lasting friend and he will advertise your shop for you.

About the worst mistake a small shop proprietor can make is to slight an old customer in his eagerness to make a new one. Ordinarily one old customer is worth two new ones.

The small shop should never cling to methods and tools of a by-gone age. It is neither difficult nor over expensive to keep methods up to date. In accomplishing this, the cordial interchange of ideas among small shops is a valuable factor, and, of course, the small shop always has access to the results of the costly experiments made by large shops.

It does not take much to give a small shop distinction. A few good, steady mechanics, a few reliable customers, a good location, personal contact with the workmen, good management, adequate tools and machinery, and a reputation for service—these things make for success.

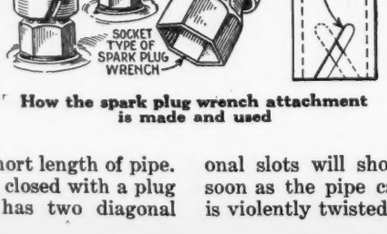
There never was a time when the small shop proprietor had a better chance to make good, provided he has a faculty for management. And the average mechanic who goes into business for himself will find it well worth while, before branching out extensively, to develop to the uttermost the possibilities in a small jobbing business.

Figuring low to get a big contract, the partners overreached themselves and could not meet their bills

To slight an old customer in order to win a new one is the height of folly

"Persuader" Loosens Stubborn Spark Plugs

IN A SMALL auto repair shop in southern Maryland a mechanic often saves time with what he calls a "spark plug persuader." He uses the ordinary type of spark plug socket wrench with a small rod through the center and two openings to suit plugs of different sizes and, in addition, a simple tool made as shown from a short length of pipe.



How the spark plug wrench attachment is made and used

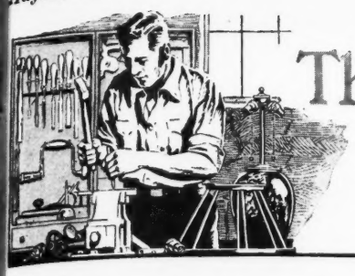
One end of the pipe is closed with a plug and the opposite end has two diagonal slots on opposite sides to fit over the rod. This tool is placed over the wrench and held so that the rod is at the bottom of the slot. It is then struck a sharp hammer blow. Response at first impact is usual and invariably the spark plug is loosened.

A study of the diagram showing the diagonal slots will show why this is so. As soon as the pipe cap is struck the wrench is violently twisted.—G. A.

Hacksaw Slot Converts Plain Nut into Useful Locknut

AN ORDINARY nut can be made into a locknut in a few minutes by cutting a hacksaw slot half way through the nut about one quarter in from the chamfered face, as shown. Tighten the nut in place and bend over the edge so that the slot is closed. This nut will never work loose but it can, nevertheless, be removed easily with a wrench. —JOHN AURES, Buffalo, N. Y.

Closing the slot locks the nut tightly



The Home Workshop

Arthur Wakeling, Editor

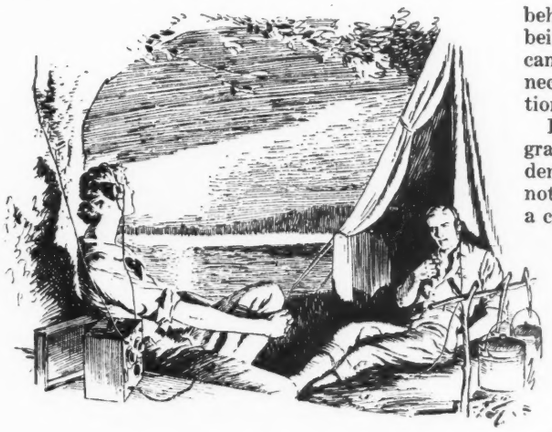
Assembling a One-Control Vacation Radio Set

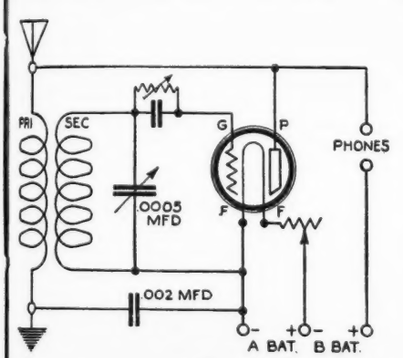
By William F. Crosby

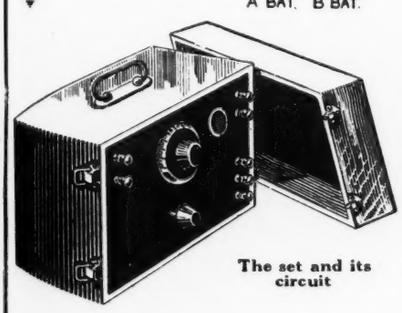
Secretary Executive Radio Council, Second District

SIMPLICITY of control, compactness, and sensitivity are the essentials for the ideal vacation radio set. These are all present in the single control receiver illustrated. Indeed, to my mind, the selectivity and ease of adjustment of this circuit make it the simplest to build and operate of any tube set.

As a radio outfit for a summer camp or for installation on a small motorboat, where space is strictly limited, this set is ideal. It costs very little to build, it does not take long to put together, and, when well made, gives results that surprise the most skeptical.







The set and its circuit

The design of the set is in line with the tendency to simplify circuits and controls. The pre-war radio set was more complicated than the average set of today, yet not as good, and in a few years receiving sets will be much simpler.

The hook-up is an adaptation of the ultra-audion circuit. The tuning is done with a condenser, although, as in all relatively critical sets such as this, the rheostat adjustment also plays an important part. The writer has made several of these sets for friends and has one of his own with which he has done considerable distance work.

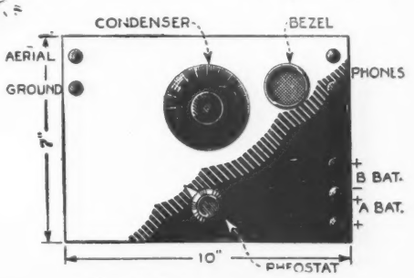
The backbone of the set is made by winding on a cardboard tube about 3½ in. in diameter two coils of wire. The first consists of 15 turns of No. 20 single cotton covered wire, and the second of 50 turns of the same wire. The space between the coils should not exceed ¼ in. If they are too close there will be a tendency toward interference, and if too far apart the signal strength will be cut down. The windings of both coils, of course, go in the same direction. Do not shellac, paint or varnish the finished coils.

One end of the 15-turn primary is connected to the aerial and the other to the ground. The 50-turn secondary is hooked to the other parts, as shown. Notice that the A and B batteries are directly in series, with the leads for the filament taken from the A battery.

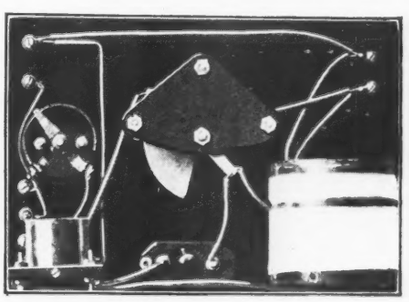
A small fixed .002 mfd. condenser is connected between the ground lead and the A battery. A Vernier attachment for the 23-plate .0005 mfd. variable condenser is desirable and it is also well to have a Vernier rheostat and variable grid leak.

Using a dry-cell tube, it is possible to include the entire set with A and B batteries behind a 7 by 10-in. panel; the cabinet being 7 or 8 in. deep. The binding posts can be placed on the panel or all the connections made internally with the exception of the telephone binding posts.

In the set illustrated in the photograph below a homemade fixed condenser of about .002 mfd is used. It is nothing more than a piece of tinfoil from a cigarette box cut in half and the halves rolled up with oiled paper between them. Connections are made to the tinfoil by means of two small wires, one at each end of the roll. This condenser is then flattened and clamped between the end plate of the variable condenser and the panel in order to protect it. If such a condenser is made, be sure the oiled paper is not torn, as a short circuit anywhere will cause the complete failure of the set.



How to lay out the panel

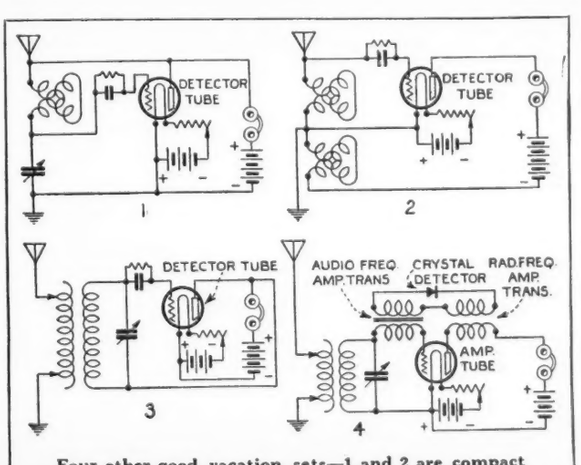


Mr. Crosby's set from the rear

With a dry-cell tube and one stage of audio frequency amplification, this set, even under the old broadcasting schedule, picked up in New York City signals from WJZ, Newark, N. J.; WGY, Schenectady, N. Y.; and KDKA, East Pittsburgh, Pa., by turning the variable condenser knob a few degrees one way or the other. This shows how sharply the set tunes. Under the new schedules, any beginner can get good results with it.

In the set illustrated in the photograph, it was necessary to place the tube socket back from the panel because the rheostat inter-

(*Turn to page 94*)



Four other good vacation sets—1 and 2 are compact single circuit sets, 3 is an ultra-audion circuit, and 4 a one-tube reflex with crystal detector

Camping Afloat Is Latest Vacation Novelty

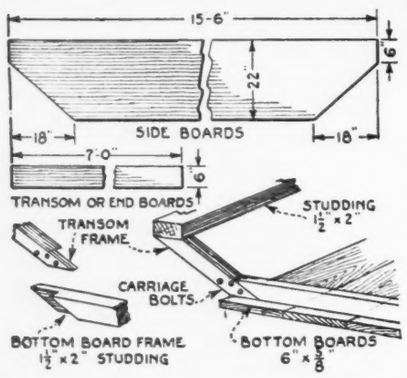
By Stillman Taylor

Widely Known Authority on Outdoor Life

THE newest way of camping is to pitch a tent on a barge. The camper then chooses a sheltered river or stream for his camping ground.

The floating camp has many unique advantages. It is easy to build and not expensive; it provides a good, comfortable canvas home with large storage places for food and other essentials; and the camper may move on and drift with the current and wind whenever he feels like picking up and changing his camp.

The camping scow is the simplest kind of a boat to build. If it is hauled out each year after use and turned bottom up out of reach of ice, it will stand up under many years of service.



How the camping scow is put together

For the sake of lightness spruce is preferred, but white cedar or almost any other wood may be used, if the builder prefers. If spruce or other light wood is selected, the side boards should be 1¼ or 1½ in. planks. It is unnecessary to have the side boards in one piece; three pieces may be used, if securely battened at 3 ft. intervals by means of 1½ by 2-in. studding. The edges of the planking should be planed to a slight bevel, giving a shallow V-shaped opening on the outside but forming a tight fit inside. In this seam is tapped oakum or cotton waste to about ⅛ in. from the outside. Then fill the seam flush with putty, first smearing thick paint over the oakum.

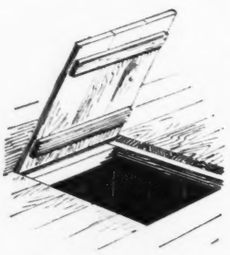
The bottom boards are nailed, with galvanized boat nails, directly to the frames. These boards should be not less than ¾ in. thick and any width may be used. These seams also are calked.

To provide plenty of stowage space, a watertight box is constructed in the center

of the scow. Access to it is gained through a trapdoor in the tent floor.

The decking is ⅝-in. boards, nailed crosswise from side board to side board with a 1½ by 2-in. piece running lengthwise in the center to stiffen it. After nailing the deck in place, paint the edges of the boards with a heavy coat of paint, and force them up tightly with a heavy chisel, as flooring is laid. Before putting on the deck, it is well to paint the boat inside with any cheap paint mixed with plenty of oil.

For mooring the camp, a heavy ring bolt should be screwed in the 1½ by 2-in. transom supports at each corner. A heavy pair of oars may be provided for poling the scow, one being lashed on deck for use in case the other is broken. A 16-ft. ash oar, such as is used in the largest fishing dories, is the best.

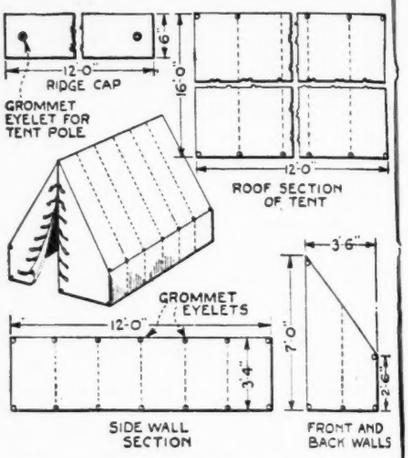


Trapdoor to storage place

A regulation wall tent gives the most room for the space occupied. Each post of the tent should extend through the deck and rest on a step on the bottom, as a mast.

For the tent 8, 10 or 12-ounce cotton duck may be used. The figures show the dimensions, which may be varied as required. The tent should, however, be the same width as the scow, so that the side walls will extend down the sides of the scow to keep the rain from driving in. It is a good plan to run a 1½ by 2 in. piece around the whole tent, making a tight joint by laying the wooden strips on woolen cloth, well coated with heavy paint. When the studding is nailed solidly in place, this will form a watertight joint.

In making the tent, first prepare the rectangular section of the roof by sewing the duck together with a lapped seam ¾ in. wide, stitched on both edges. Then make the front and



Wall tent recommended for water camping

back walls and the side walls, as shown, and sew all together in that order, using a sailmaker's needle and common white string, well waxed. The canvas ridge cap is sewed on last.

A 2 by 2 in. piece may be planed octagonally for the two upright poles and another, rounded over the top, will serve for the ridgepole. A spike 6 in. long is driven in the ends of the two posts, and corresponding holes bored in the ridge pole.

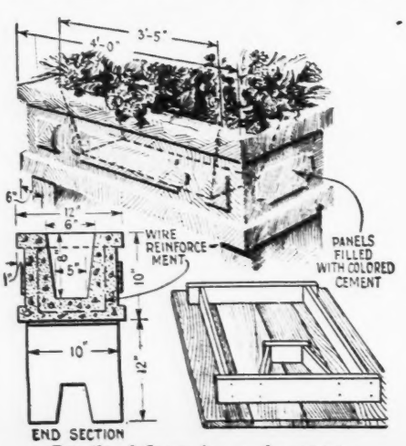
The scow with the tent set up is hard to row but fairly easy to scull, and a big rowlock or scull plate should be fixed to the roomy front deck for this purpose.

Building a Concrete Flower Box and Garden Seat

TO MAKE the supports for a concrete flower box or garden seat, prepare a form of ⅞-in. wood, as shown. Then mix one part of cement and two parts of clean sand to a mushy consistency, wet the form well, and pour in a layer of concrete about 1½ in. thick. Cut a piece of heavy chicken wire of close mesh, or of regular woven wire reinforcement, lay it on the surface of the concrete, and put in 1½ in. more of the concrete.

After a day or two, remove the form very carefully, and brush the surface of the concrete with a mixture of pure cement and water. A second support is then made in the same way.

The box form is next built up on a board platform. It is possible to provide raised or recessed panels, which can later be filled or coated with colored cement.



Details of flower box and supports

A form is also made for the interior of the box, and this should be filled with sand or earth to prevent it's collapsing. Reinforcing should be provided as shown by the dotted line in the end section.

The box form is filled with a 1 to 2 in. mixture, like the supports. When finished the box is cemented to the supports with cement mortar.

If a seat is desired, simply make a slab of concrete with wire reinforcing in the center and mount it on the supports. Wooden molding will provide an ornamental edge and if none is available, a molded form can easily be improvised by building up the edge pieces with several strips that have been planed to a decorative profile.

Two bags of cement should be ample to make the complete box, and the seat will require less.—L. G. S.

How to Color White Flowers Artificially for Special Uses

TO KNOW how to color flowers artificially is sometimes valuable when preparing floral decorations for special occasions or to suit a particular color scheme, notably in obtaining green flowers for St. Patrick's Day.

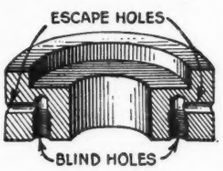
"Dyed" Flowers

If the stem of a flower such as a rose is dipped for one hour in a solution of aniline dye it will absorb some of the coloring matter. Blue or violet dye will change the color of any white flower to a blue violet and a solution of safranine to a scarlet red. By using safranine and alum, the color of many light red or pink flowers is changed to a dark red.

White flowers placed in a cold solution of picric acid or alum and aniline orange change to a yellow color. Green colored specimens are obtained by allowing flowers to stand in a green aniline dye.—E. B.

Steam Pockets in Hardening

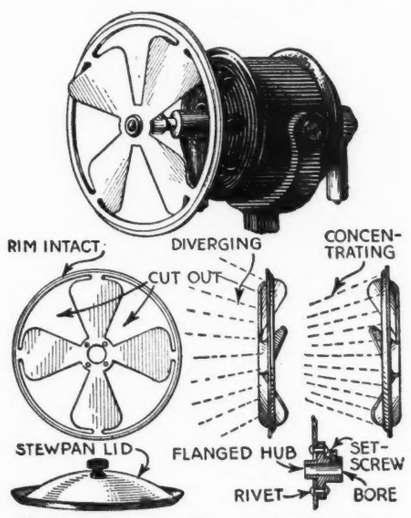
AMATEUR mechanics sometimes have trouble in hardening steel because of blind holes in which steam is generated when the article is being quenched in water or brine. Not being able to escape, the steam is apt to split or crack the steel. To prevent this, drill small escape holes into the blind holes, as shown in illustration.—C. M.



Neat Electric Fan Made from Aluminum Kettle Lid

ALUMINUM kettle lids will make neat and good looking electric fan blades, replacing the tarnished, bent or broken ones of the old fan.

An aluminum lid of the right size is selected and cut out to the shape shown.



Cutting and mounting an aluminum fan

Leave ample metal in the center for fastening the brass hub piece.—J. R.

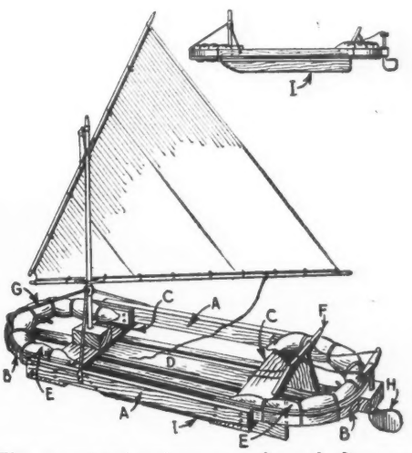
Sailing Raft Provides Novel Sport

By Lawrence B. Robbins

THIS unique, non-sinkable, one-man sailing raft is great sport for swimmers. It can be built quickly and cheaply by anyone with moderate skill in handling carpenter's tools.

The sides A-A are two pieces of 1-in. scantling about 5 ft. long and from 3 to 4 in. wide. Place them 3 ft. apart, parallel to each other, and nail two spreaders C-C made of wide boards 3 ft. long to the under sides at each end.

The bow and stern are heavy barrel hoops B-B opened and spread apart 3 ft. The open ends are nailed or bolted to the ends of A-A. It will make a stronger job if two barrel hoops are nailed or riveted together and then attached as shown. The entire length should now be about 8 ft.



The completed swimming raft and diagram showing shape of the keel

Bolt a long plank D to the middle of the under side of the spreaders and nail a narrow board at each side of D.

Buoyancy is obtained by the use of two large automobile inner tubes E-E. Choose tubes that, while beyond use as tires under high pressure, are airtight enough to hold air for a considerable time. By judicious patching, you can perhaps make them perfectly airtight for the light pressure to be used for this purpose. Cut each tube clear through opposite the valve stem and vulcanize the ends tightly to form a long rubber tube. If you cannot do the vulcanizing yourself a tire repair man will do it for you.

Lash one tube to the inside of each barrel hoop. The lashings should be tight enough to hold the tube in place but not to pinch it.

How to Step the Mast

Put a wooden back F across the middle of one spreader and bolt an iron tripod G over the center of the other spreader. The center of the tripod is an iron ring large enough to take the mast. Directly below the ring should be a hardwood block for the mast step, bolted securely to the top of the spreader.

Turn the hull over and fasten a solid block to the middle of the stern end. Bore a hole in the center to take the round post of rudder H, which can be either metal or wood. Fasten with angle irons a piece of stout board cut somewhat after the shape shown at I to the center of the bottom of D to serve as a keel.

The sail easiest to make is the lateen. The boom and gaff should both be about the length of the boat, which is 8 ft. Spread them at an angle and cut the cloth to fit. Use light duck sewed together along the selvage edges. Three widths should be enough. The spars may be made of strong wood or bamboo poles.

The sails are lashed to them.

Make the mast about 6 ft. high and large enough to step into the iron ring on the tripod. Square the end to fit a square hole in the block. A leather loop holds the spars to the mast in such a position that the boom tips up and the gaff points nearly vertical. Tie the gaff to the mast tip with strong rope or arrange a pulley as shown and fasten a "sheet" to the boom near the outer end. A tiller with a rope in each end should be fastened to the end of the rudder post.

Sailing Partly Submerged

Inflate the tires, launch the boat, step the mast and sail, lie down on the plank D, resting your shoulders on the back F, grasp the sheet and the tiller ropes, and you are ready for a sail. While your body will be partly immersed, the resistance will be small and you should be able to get fair speed out of the raft in a good wind. Since you are not afraid of getting wet, you can travel in the roughest water.

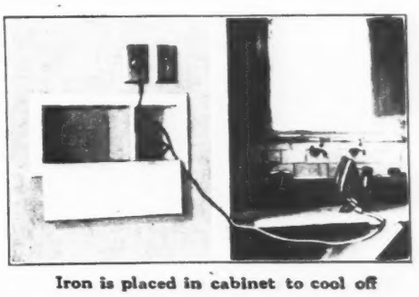
Several of these boats can be depended upon to furnish "barrels" of fun at a summer camp.

TO KEEP a bottle of thick, viscous liquid like rubber cement ready for instant use, turn it upside down in a tumbler or other glass container while still corked. The liquid then is always close to the mouth of the bottle. Before I discovered this little "kink" I frequently used library paste when I now use rubber cement.—N. G. NEAR.

Asbestos Lined Cabinet Holds Electric Iron

TO PROTECT our baby from the ever-present danger of being burned by the electric iron, I constructed the asbestos lined cabinet illustrated.

The built-in box is lined with heavy asbestos and that in turn is covered with sheet metal, fitted by a tinsmith. The smaller compartment is for the cord so that there is no danger of the insulation being burned by the hot iron coming accidentally in contact with the wires.



Iron is placed in cabinet to cool off

When the ironing is finished the iron is placed in the box to cool off. It is beyond the reach of the baby and shut out of sight until needed again. The ironing board also is arranged to fold up in a cupboard.—J. C. KNOLLIN, Los Angeles, California.

How to Construct Rustic Camp Furniture

By F. E. Brimmer
Author of "Autocamping"

HOW about building a rustic buffet, serving or tea table, and phonograph cabinet for camp? This may seem a complicated task but actually it is not at all difficult.

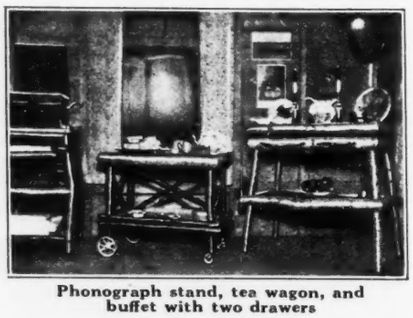
Most folks use nails in making rustic furniture joints but long screws are far better. Recently I saw a camp bedstead secured with bolts, each pole being flattened a bit where the bolted joint was made. A rustic pole woodbox also might have its frame bolted together to advantage. In short, wherever furniture must stand rather heavy strains, 4-in. carriage bolts are best.

The buffet, serving table and phonograph stand illustrated, are made of yellow birch poles, and two kinds of joints are used; one the countersunk screw joint; and the other, a mortise and tenon joint. The latter can be made most easily by boring a 1-in. hole to form the "mortise" and whittling down the end of the stick to make the corresponding "tenon." Such a joint is locked by driving in a finishing nail from the side, or by starting a small wedge into the end of the tenon. This will expand the end of the tenon automatically when the wedge is driven home.

Birch Slabs Cover Framework

The buffet poles are about 2 in. in diameter, although the four legs are slightly more than that at the base. The height is 40 in., length 46 in., and width 21 in. The top and shelf of the buffet are of matched pine boards cleated together by a frame such as you find underneath the top of an ordinary kitchen table. The four legs are fastened to this frame with screws. Birch slabs, carefully split, are attached to the edges of the top and over the frame, hence hardly any suggestion of boards is visible.

Within the frame, just under the top, two ordinary drawers 3 by 18 by 20 in. are



Phonograph stand, tea wagon, and buffet with two drawers

placed. The front of each is covered with a slab of birch, and bent sticks nailed on with finishing nails serve as handles.

The shelf is of matched pine boards 2 in. longer and wider than the top. These boards are cleated together, and then the legs are fitted and held by long countersunk screws. The edges of this shelf are also camouflaged by birch slabs. To make neat corner joints, use a miter box.

The serving table or tea wagon presents few more difficulties than the buffet. The two larger wheels are ones salvaged from a discarded baby buggy, while the smaller swivel wheels are from the hardware store. The height of the wagon is 28 in., length 26 in., and width 18 in. The shelf is the same size as the top. Braces give the table stability. The larger wheels are attached to the lower ends of the legs by means of long lag screws, with shanks just the right size to form axles.

Almost every camp boasts a phonograph or radio cabinet but these usually lack a suitable stand. The stand illustrated solves this problem and also makes a convenient place to keep record albums, magazines and newspapers. A pull-out shelf, which inclines downward a trifle when fully extended, holds the record album in a convenient position.

"Swelled Front" Phonograph Stand

By the careful selection of sticks, this cabinet is given a "swelled out" appearance. The height is 40 in. and the top board is 2 ft. square. The legs are secured to the frame by mortise and tenon joints, and the joints for the front and rear sticks of the shelf are the same. Instead of boards for the shelf, small 1-in. poles are used. The shelves and even the tops of the other pieces of furniture could have been made in the same way.

Yellow or white birch are perhaps the best for rustic furniture but any variety of slim, straight poles will do. Soft wood, wood that is not clear of limbs and knots, or timber that splits and cracks too readily is not serviceable. No varnish or preservative need be used on the unpeeled poles.

WHEN using bichromate of potash to stain mahogany or other woods, be careful to sandpaper the work lightly after the solution is dry in order to remove the powdery residue left by the stain.

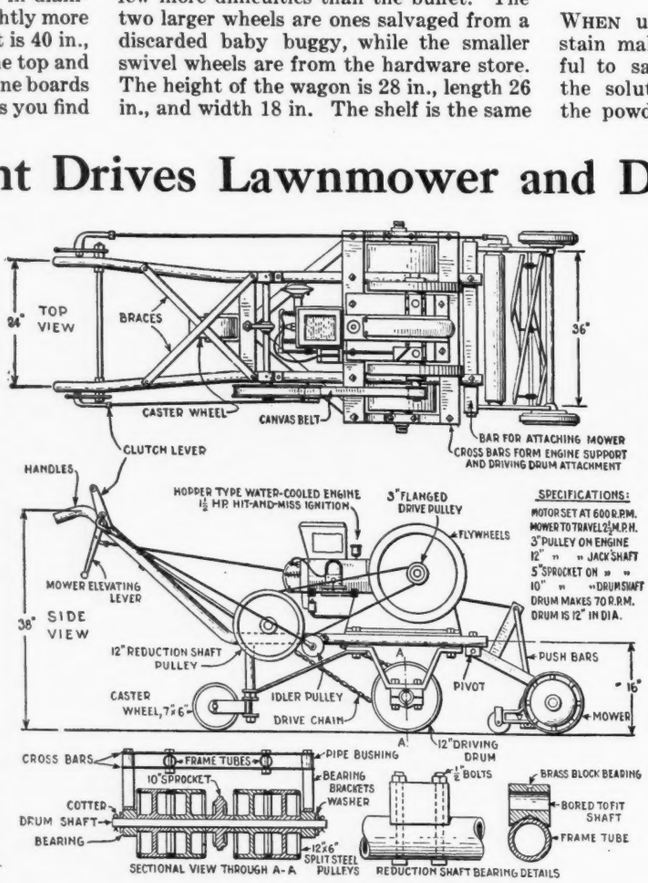
Power Plant Drives Lawnmower and Does Chores

By Joe V. Romig
Machine-Tool Designer and Builder

BUILT of easily obtained materials, the power-driven lawnmower illustrated will keep in condition the lawns of large estates and golf links at a minimum of cost and labor. It also serves as a portable power plant for such odd chores as sawing wood, churning butter, and running a cream separator or a washing machine. Its utility is increased because it will propel itself.

Used as a lawnmower, because of the wide surface of the driving drum, it smooths the ground to a surprising extent. This is an especial advantage in sowing grass seed.

Pipe and flat steel, which form most of the framework of the machine, can be bought, as well as the pulleys, at any machinery depot. Small gasoline power plants can be had for less than $50. The size and design of the motor base determines the final design of the mower. A 1½ hp. motor of the hit-and-miss type of ignition, preferably water cooled, is a good type for general utility.



Top and side views of the lawnmower, details of the driving sprocket and drum, and construction of the jack-shaft bearings

The mower should be from 30 in. to 36 in. wide, and its construction also has a bearing on the final design and width of the machine.

The extra heavy frame of 1½ in. pipe is bent in a blacksmith shop to the shape shown. Cross pieces of ½ in. by 3 in. flat iron are then fastened to the pipe frame with ½-in. bolts, so spaced as to form a support for the motor and extend out from the frame for the braces on which are bolted the bearings of the drum shaft. These drum shaft bearings are ordinary solid pillow blocks, bolted to the lower side of the braces.

The drum is built up of four pulleys of the split steel variety. A 10-in. sprocket is placed between the center pulleys, and all are either keyed or clamped to the drum shaft proper. Collars and cotter pins are used to keep the shaft in its bearings.

The caster wheel is a solid pulley, in a flat iron hanger. The whole is pivoted on a ¾-in. bolt, hung from the rear cross pieces and braced sideways by the two diagonal braces, as shown.

About two-thirds of the total weight of the machine should rest on the drum and the remainder on the caster wheel. This distribution of the weight is necessary to counterbalance the weight of the mower when it is lifted off the grass.

The handles should be about 24 in. apart and well braced. The mower is hung on a flat iron cross brace, which is bent down at each end, and fastened to the extreme front of the frame. Flat pieces form links to connect the mower to this cross piece. An upright arm with a small brace is bolted or riveted to the left link;

(*Turn to page 101*)

Splendid Blueprints for Your Summer Work

Arbor, Bench and Swing are Three Attractive Projects from *Popular Science Monthly's* Famous Series of Home Workshop Drawings

OF ALL the noteworthy projects in POPULAR SCIENCE MONTHLY'S series of blueprints, perhaps the most timely and useful for outdoor construction in the long, light evenings of midsummer are the arbor, the combination bench and table, and the porch swing illustrated. These are simple to make, do not cost a great deal for materials, and are excellent for dressing up the porch and garden.

Perhaps you have noticed these designs among the thumbnail sketches that have been published from time to time to illustrate the blueprint series. They are again being published as a result of a number of requests from readers.

The new perspective assembly drawings have been especially prepared to show at a glance the over-all dimensions and give the general construction clearly enough to be followed without difficulty by any man or boy who is handy with woodworking tools.

Arbor Has Two Roomy Seats

The arbor, with its arched top, quaint gate and two roomy seats, is a perpetual invitation to linger in the garden. It is built of cypress or other durable wood and rests on 4 by 4-in. sleepers buried in the ground.

The posts are 2¾ by 2¾ in.; the slats ⅞ by 1⅞ and ⅞ by 2 in.; the rails ⅞ by 3 in.; the top bows 1⅛ by 2 in.; the gate rails ⅞ by 2⅝ in.

The roof bows can be made either by bending the 1⅛ by 2 in. pieces after they have been softened in boiling water or with steam, or by building up the curve from two layers of ⅞ in. stock sawed to shape.

The porch swing, made of oak, ash, chestnut or other hardwood, is distinguished by the graceful shape of its back. Both the seat and back are curved to make them comfortable.

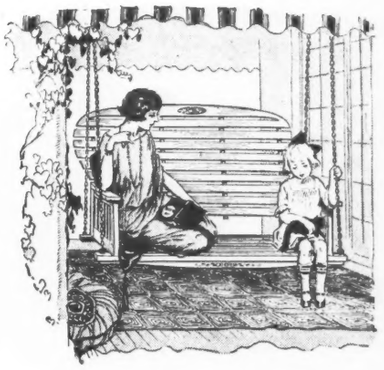
Two stretchers of sleepers 1¾ by 2¾ in. by 4 ft. support the swing. The cross rails of the seat are 1¾ by 1¾ by 16 in.; the four back braces are cut from one piece 1¼ by 12 in. by 2 ft. 2 in. The slats are ½ by 2 in. stock.

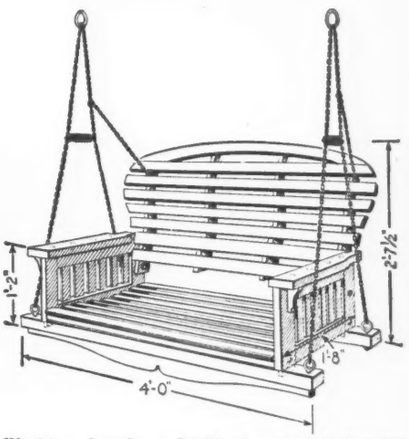
The combination bench and table is ordinarily used as a decorative bench for the veranda or sun porch, but it can be converted instantly into a luncheon table. The seat covers a capacious box.

White pine, whitewood, or other close-grained soft wood is used, and the piece is painted or enameled and ornamented as suggested in an article, "How to Paint Decorative Home Furniture," on page 76 of the June POPULAR SCIENCE MONTHLY.

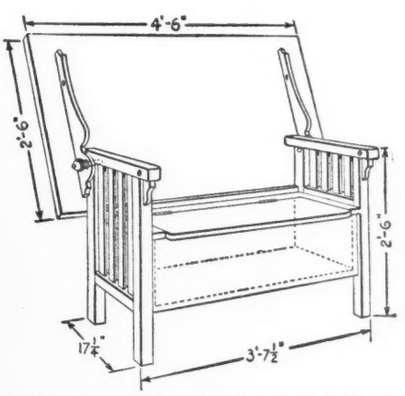
Complete working details, many of them full size, and an exact bill of materials can be obtained for each of these from the Blueprint Service Department of POPULAR SCIENCE MONTHLY for 25 cents apiece, to cover the cost of blueprinting, handling and mailing. The designing, detailing and drafting, for which no charge is made, are a part of the magazine's contribution to the success of your home workshop.

An especially useful blueprint is being prepared for distribution next month. It shows the construction of a baby's combination crib and play pen with folding top and other distinctive features that make it a most desirable addition to any home where there are young children.

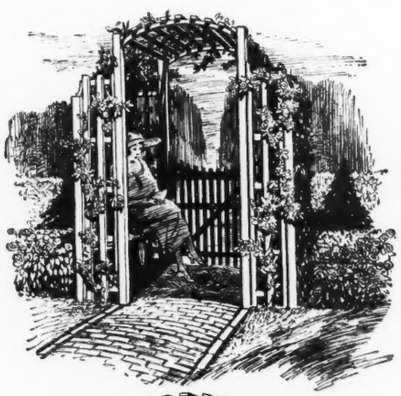


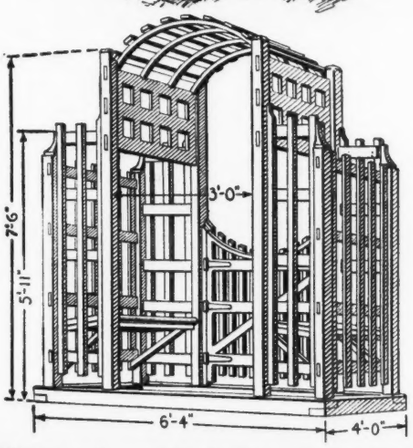


Working details and bill of materials for this ornamental porch swing are contained in Blueprint No. 10



Combination bench and and tilt-top table for veranda or sun porch, detailed in Home Workshop Blueprint No. 11





Sketch and assembly drawing of the arbor, which is fully described in Home Workshop Blueprint No. 9

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Send me the blueprint, or blueprints, I have checked below, for which I inclose .....cents in stamps or coin:

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Better Shop Methods

How Expert Mechanics Save Time and Labor

Using a Drill Press as a Small Slotter

By Joe V. Romig
Machine-Tool Designer and Builder

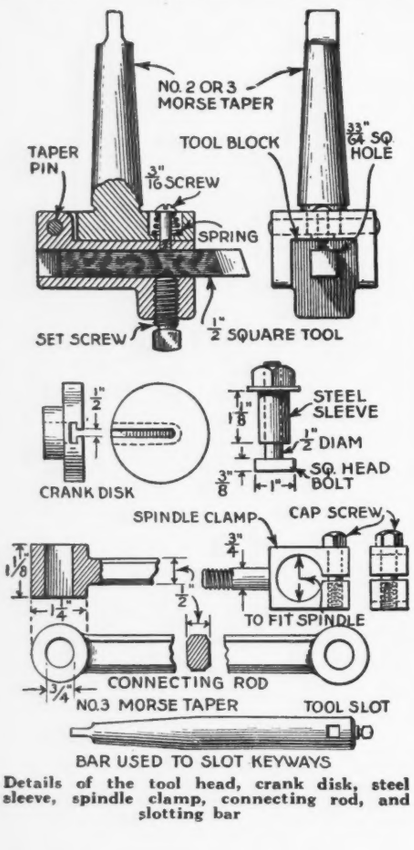
SHORT stroke slotting on small tool and die work is often done on the shaper or large slotter for want of a small slotting machine. If one of the drill presses in the shop is not kept constantly busy, it can be converted into a small slotter that will do fine and accurate work.

The necessary modifications are not expensive to make and the machine will save time on many small jobs that have to be shaped out to a layout line or require deep recesses that are difficult to machine on the shaper because of the size of the head.

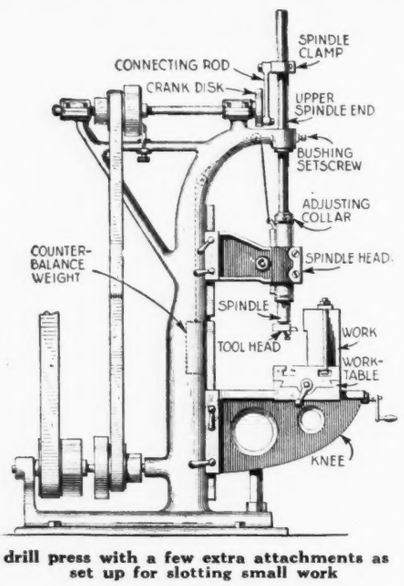
The drill press selected should have a double table feed, to allow the work to be fed in either direction. The two bevel gears on the top of the spindle are removed and in place of the small gear on the top horizontal drive shaft is substituted a crank disk. This is keyed in place and has a T-slot milled across the center line to take the variable stroke crank pin.

Usually the driven gear of the bevel set has an extended hub that runs in a bushed bearing at the head of the column, so a bushing must be made and inserted in its place to support the upper end of the spindle. A spindle clamp also is made of cold rolled steel with a turned down pin, as shown in the detail drawing. A connecting rod joins the crank pin and spindle clamp.

To prevent the spindle's turning, the ball



Details of the tool head, crank disk, steel sleeve, spindle clamp, connecting rod, and slotting bar



A drill press with a few extra attachments as set up for slotting small work

race is removed and fiber washers are inserted. The lock adjusting collar on top of the spindle slide is then tightened to hold the spindle rigidly.

To allow fine and accurate work, the spindle slide should be adjusted for a smooth up and down motion without any undue play, and the rack of the slide should be adjusted until there is no side motion.

As the head is clamped to the column and the slide is counterbalanced, the power used is slight. With the cone pulley arrangement and back gear shift, the power and speed range available is ample.

How the Tool Head is Made

An ideal tool holder for the slotter is made as shown. The tang should enter well into the drift opening to prevent the holder from turning under the strain of the cut. The rectangular head is shaped out to receive the tool or apron block, which should be a neat sliding fit in the head. It is pivoted by means of a taper pin. To give the tool clearance on the up stroke, a spring is provided to pull the toolblock up against its seat. The details explain themselves, although the maker should be cautioned to drill the counterbored hole a trifle ahead of the center to allow the screw and spring free play when the head pulls down. The hole in the toolblock should be a trifle larger than the ½-in. steel bits used, as the strains of cutting are in an upward direction, and the tendency of the tapered shank is to tighten rather than to loosen.

Bars of various sizes can be made for cutting keyways and deep slotting, although the usual boring bar used on the drill press will serve for this purpose.

When taking straight cuts, the tool holder should be faced straight, the head toward the work, and on side or recess work the head is slanted toward the side worked on. The tool head becomes, indeed a universal apron head.

This conversion of the drill press does not involve any fundamental changes that prevent the machine's being restored to its original purposes when necessary, and in many ways the converted machine is handier than its companion machines of heavier type, as the lifting and placing of the ram is easier, there is greater range up and down, and more light for the operator, as well as the possibility of using the machine both as drill and slotter at one setting or chucking of the work.

Accurate Surface Plate Aids in Making Speedy Layouts

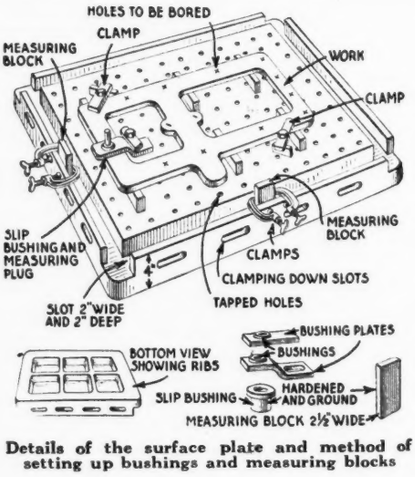
By Henry S. Laraby

FOR laying out work accurately and with the least loss of time, one or more laying-out surface plates made as shown below will prove a valuable addition to the equipment of any machine shop.

Small plates for tool or gage work should measure about 12 by 18 in. and in that size may be made of soft steel or cast iron. Large plates for heavy tool or machine work run up to several feet square and are of smoothly machined cast iron.

It is essential that the plate be machined perfectly square and the slot made square with the edges, so that the plate may be turned on its side when necessary.

The work is located squarely with the sides and fastened by means of strap clamps. A slip or fixed bushing with a hole



Details of the surface plate and method of setting up bushings and measuring blocks

through it the same size as the hole wanted in the work is forced into the bushing clamp. A ground plug is then fitted into the bushing and used for locating the bushing. Measurements are taken from measuring blocks clamped at any convenient place along the side slots.

The slots in the sides permit the plate to be clamped to the miller for cutting, slotting or boring the work without removing it from the surface plate.

Shop Lamp Has Universal Adjustments

By B. R. Wicks

FOR the home drafting table and the small shop or garage, the universal electric lamp illustrated has marked advantages. It can be clamped to a table, chair, box, lathe, drill press, or to any edge that is within the range of the clamp. It can be adjusted to any height within its limits and the light can be set at almost any angle to furnish the best illumination for the work, whether drafting, reading, machine, or pattern work. It is also so designed that any style of shade can be used, regardless of its shape, in the holder, No. 15.

Having made a set of patterns for the five parts that have to be cast, I found that many of my friends wanted castings in iron, bronze or aluminum as soon as they saw how neat and useful the finished lamp was, and I still have castings made from time to time.

The parts used in the construction are illustrated in detail. No. 1 is the lamp socket holder that swivels on No. 4 and is held in position by the clamp screw No. 9, with a 5/16-in. spring washer under the head of the screw. Number 2 is the lamp socket holder cap. The surfaces between Nos. 1 and 2 are filed smooth and flat and drilled and tapped for screws No. 3. These parts form the clamp to hold the lamp socket No. 14, in place.

Number 4 forms the lamp socket head: The 11/16-in. barrel is drilled and reamed to 7/16 in. for the spindle No. 12. The boss *B* is drilled and tapped 5/16-18 thd. for the gib screw, No. 8, which should screw in tight, the play being adjusted by the thrust block No. 6, so that it will swing easily on the spindle No. 12. The boss *A* on No. 1 faces *A* on No. 4.

The clamp screw No. 9 is made from a 5/16 by ¾ in. hex. head cap screw with a 3/16-in. drill rod handle driven in. The 9/16-in. barrel is drilled and tapped 5/16-18 thd. and faced to 1 in., so that the locknuts on the swing rod No. 13 will set square.

Number 5 is the height-adjusting collar bored and reamed to 7/16 in. to fit No. 12; the boss *C* is drilled and tapped 5/16-18 thd. and held in position by means of the screw No. 7. The thrust block No. 6 is placed between the screw and the spindle to prevent cutting into the spindle when the screw is moved.

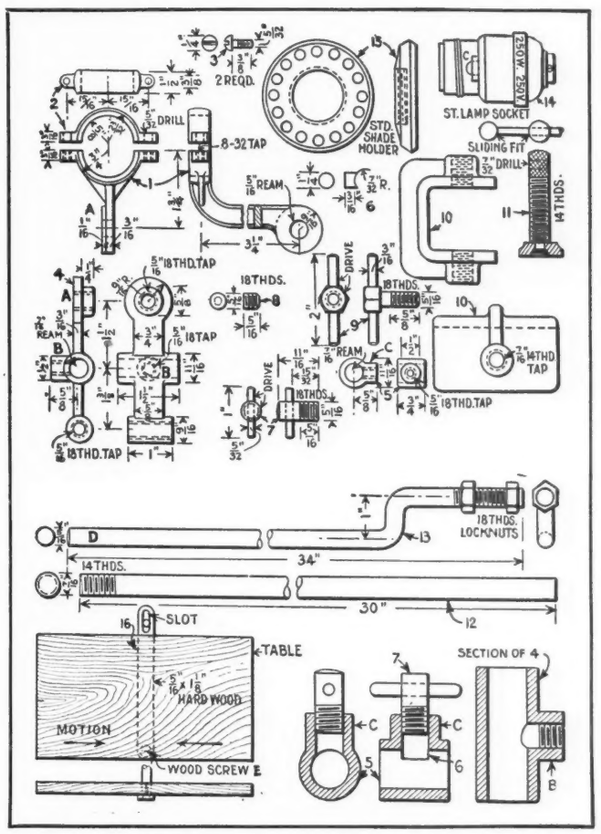
Number 10, the clamp, is an iron casting, drilled and tapped for the end of the spindle No. 12, and the clamp screw No. 11, which is made from cold rolled steel.

Number 13, the swing rod, is made from 5/16-in. cold rolled steel. A piece of hard wood, No. 16, 5/16 by 1⅛ in., and of a length to be determined from the size of the table to be used, has a slot in one end to engage the end of this swing rod *D*, and is fastened under the table with a wood screw, *E*, so that the light can be moved from one side to the other, regardless of the height, simply by manipulating the lever. This can be done with one hand without changing the position or interrupting the drafting or other work that is under way. Time is saved and a direct light is kept on the work.

The universal lamp

List of Lamp Parts

No.	Part	Material	Req'd
1	Lamp socket holder	C. I., bz., or alum.	1
2	Lamp socket holder cap	C. I. bz., or alum.	1
3	Lamp socket holder cap screws	8/32 by ⅝ oval head	2
4	Lamp socket holder head	C. I., bz., or alum.	1
5	Height adj. collar	C. I., bz., or alum.	1
6	Shoes	¼ brass rod	2
7	Height adj. collar retaining screw	C. R. S. with 5/32 drill rod handle	1
8	Adj. screw for 4	5/16 by 5/16	1
9	Angle adj. clamp screw	5/16 by ¾ hex. caps. with 3/16 D. R. handle	1
10	Table clamp	C. I.	1
11	Table clamp screw	C. R. S.	1
12	Lamp spindle	C. R. S.	1
13	Swing rod	C. R. S.	1
14	Lamp socket	Stock	1
15	Shade holder	Stock	1
16	Spring washer (Not shown on drawing)	5/16 steel, stock	1
17	Hard wood strips	5/16 by 1⅛	1



Details of the lamp parts, standard, and mechanism for swinging the light from side to side. The parts are numbered to correspond with the list of materials.

Rotary Tools Increase Speed and Safety in Press Work

By C. M. Wilcox

MECHANICS and designers who have to deal with press work may find useful suggestions in the design of the set of press tools illustrated. This is a "safety first" setup and couples speed and accuracy with a minimum amount of handling.

The tools are used to close formed sheet metal rolls on buckles. The buckles with rolls in position are placed in the dies at the front of the tools, and are automatically carried up into position where the punch descends and performs the closing operation. Each buckle is then carried down the back side to tumble into a trough, which guides it into a receiving box or can.

A cast-iron die holder drum, with a bearing on both sides, is keyed to the shaft and has eight hardened steel dies embedded in its face, spaced 45 degrees apart. An eight-tooth ratchet is keyed to one end of the shaft and a locking disk having eight equally spaced milled slots, is fixed to the opposite end.

Attached to one side of the punch block is a hook lever free to work on its stud. This stud is so located that the hook lever swings against the ratchet of its own weight and no spring is required.

On the opposite side of the punch block is hung a swing lever in which is riveted a stop pin. A second pin is riveted to its lower extremity. Held to the side of the shaft bearing by means of a screw stud

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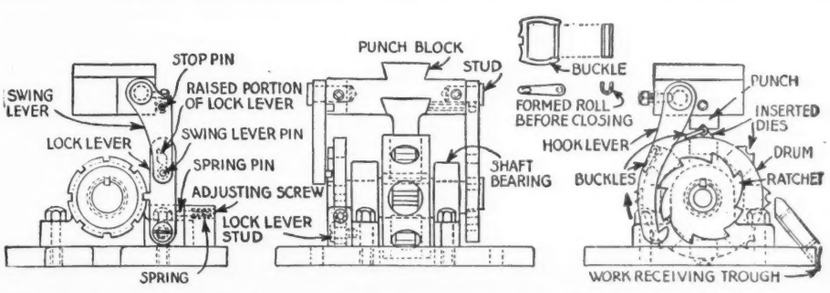


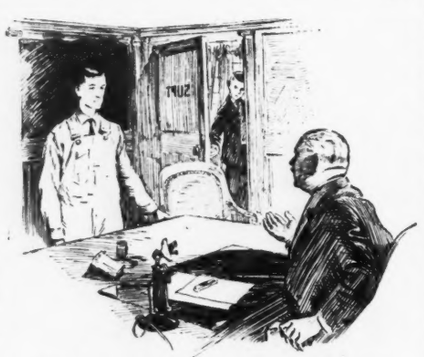
Diagram showing setup of vertical rotary press tools for closing formed metal rolls on buckles and performing similar press operations

Toolmaker Quadruples Pay

As a message of inspiration to mechanics, this article has rarely been equalled. It is a true story and one of the many excellent contributions to POPULAR SCIENCE MONTHLY'S contest, "How I Got that Better Job." The writer asked, however, that his name be withheld from publication.—THE EDITOR.

DURING 1906 I was working as a toolmaker in a shop in New York state at the highest rate of wages then paid for that class of work. I was 28 years old and married.

On considering my situation carefully, I concluded that I had advanced about as far as I could ever expect to go if I continued to depend on my manual skill alone. It was evident to me that I needed more education and since the only way for me to obtain it was to study at home, I took up a mechanical course with a correspondence school.



"We are going to organize a planning room and shall need a foreman——"

I studied for about two years, and while what I learned was of assistance to me in my work in many ways, I was no better off financially. It seemed that I could not get a better job because no opportunity offered for me to demonstrate my ability to fill one.

My opportunity came in a very unexpected manner. The concern I was working for took a contract to furnish some special machines and deliver 500 in two weeks. I was told that since work was slack in the toolroom, it was desirable to transfer a few toolmakers to production work to get the job out on time and was asked if I would be willing to be one of them. I agreed readily and was assigned a job of drilling and tapping 3/8-in. blind holes in a cylinder.

This work was being done on a three-spindle drill, one spindle fitted with the tap size drill, one with the body size drill for counterboring about 1/16-in. deep, the other with a friction drive tapping attachment. I was told that the regular output was eight cylinders an hour, and asked to better it if I could. The material was cast iron, and the tapping operation was slow, since it was required to have a full thread clear to the bottom of a hole 7/8 in. deep. The chips gave considerable trouble and made it necessary to back out the tap and clean out the hole three times for each hole.

Speeds Up the Tapping

I started in with a dry tap, finishing each hole as I went and blowing out the chips with a small tube. In this manner I was able to do five an hour. Then I tried finishing all of the drilling on a cylinder, shaking out the chips, and running the tap into each hole as far as it would go, then shaking out the chips and running it in again until the tap had been in each hole three times and the cylinder completed. In this way I reached the required output of eight an hour. I learned afterward that this was the method followed by the regular operator.

At that time I was studying hydraulics in my course, and naturally the subject was more or less in my mind. I considered what would happen if those holes were filled with liquid and the tap run into the hole. I concluded that the fluid would have to come out of the hole by way of the flutes alongside the tap; also that the more rapid the tap was driven in, the faster the fluid would have to flow out.

I filled one of the holes with oil and started the tap into it, with the result that it went clear to the bottom without the friction slipping. Then I speeded up the tapping spindle, as the oil would keep the tap cool. After doing the drilling and shaking out the chips, I filled all the holes with oil and tapped them out. In this manner I got out 15 cylinders an hour and the second day was able to reach an output of 16 cylinders an hour.

The job was one of considerable importance and the superintendent was giving it his personal attention. The third day he came to me and said, "Bill, they tell me that you just doubled the output on this operation yesterday and I want to know how you did it."

"Well, sir," I replied, "blind holes are always rather troublesome to tap because of the difficulty in removing the chips. I seem to have overcome that by filling the holes with oil first, then, by running the tap in rapidly, the oil is displaced so quickly that it flows up the sides of the tap with sufficient force to carry the chips with it."

I demonstrated it to him, adding, "Of course, you will have to add about a quart of oil a day to the cost of the job!"

I Grasp My Chance

He said, "That is negligible. With oil at 40 cents it would be economy if you used five gallons. How did you come to think of it?"

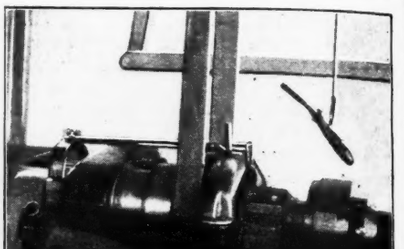
Here was my chance, and I grasped it. I replied, "Well, you see I have been studying mechanics with the Blank Correspondence Schools for the past two years and just now I am studying the paper on hydraulics. This tapping problem appeared to me a simple matter of displacement."

"Simple enough," he replied, and walked away.

In a couple of weeks, when I was back on my old job, a messenger told me I was wanted in the superintendent's office, and on presenting myself, I was told that the firm was going to systematize somewhat and that they needed some one to help organize a planning room. I was asked if I would care to go to a certain concern in the East and absorb what I could of their methods during a period of a month or so, then return and help with the installation of the system. I agreed and in about three months was given the title of "planning room foreman," a position I held for about five years. Then I had an offer from the concern with which I am now connected. My present salary is more than four times what my wages were at the time I started studying.

Additions to Lathe Equipment Save Machinist's Time

TO STOP quickly the rotation of his lathe, a Los Angeles machinist uses the shopmade brake illustrated. Its frame consists of a length of strap iron attached rigidly to the lathe bed and cone housing about 1½ in. above the largest cone. To the left end of the strap a flat spring is fastened, its natural elasticity holding it against the underside of the strap. This spring carries over the largest step of the



A quickly made braking device and an always handy counterbalanced chuck wrench

pulley a small brake lined with automobile brake lining.

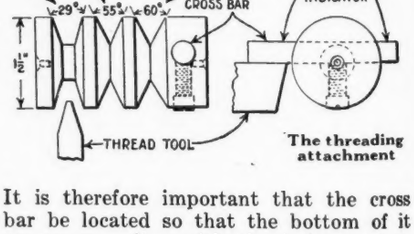
To press the spring and brake against the pulley, a crank of 3/8-in. steel rod, flattened at one end, is pivoted to the cone housing in such a way that the expanded, cam-like end lies between the right end of the spring and the strap. Turning the crank forces the spring downward and operates the brake.

The same machinist keeps the chuck wrench handy by hanging it above the headstock on a rope that passes over a pulley and is fastened to a counterweight.

A shelf on a level with the lathe ways supports the chucks not in use.—EDWIN M. LOVE.

Fixture for Setting Thread Tools

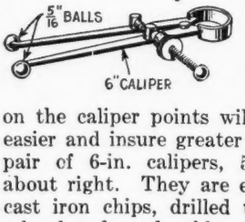
THIS handy fixture for setting thread tools is placed between the centers of the lathe and leveled by means of the cross bar, as indicated. The bar also serves for setting the thread tool at the right height.



The threading attachment

It is therefore important that the cross bar be located so that the bottom of it comes on a line with the lathe centers. The fixture is made of machine steel and left soft.—HENRY S. LARABY.

Making Ball-Point Calipers



WHEN much inside calipering is to be done, the addition of steel balls on the caliper points will make the work easier and insure greater accuracy. For a pair of 6-in. calipers, 5/16-in. balls are about right. They are easily annealed in cast iron chips, drilled to fit the points, rehardened, and soldered to the calipers. Outside calipers can be fitted with ball points in the same way.—JOHN AURES.

the closing operation.

Diagram showing setup of vertical rotary press ... buckles and performing similar press operations

Hand Boring Bar Useful in Small Shop

By Robert S. Lewis

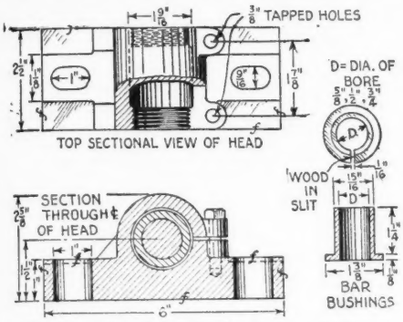
ONE of the simplest yet most useful tools, especially for the home machinist, model maker, and small shop mechanic, is a hand operated boring bar.

Many jobs too large for the only lathe in the shop can be bored out and faced on the ends with this little machine. Although the feed range of the bar is limited to 3½ in., holes of any length can be bored by shifting the bar when its limit of travel has been reached.

To use a hand operated boring bar a smooth surface or workplate is necessary, and the one illustrated in the third column is a simple and serviceable design.

Assuming that the worker has a plate of convenient size or can use an idle worktable, if in a machine shop, the construction of the boring bar and its attachment is as follows:

The head is a bearing-like block, made to the size shown. If it is desired to avoid making a pattern and doing much machine work, an ordinary pillow block of suitable size will serve. All four sides of the base are shaped up perfectly smooth and square with each other, and the piece is then mounted squarely on an angle plate on a lathe and



Working details of the head, for which a pillow block bearing can be used, and the bar bushings

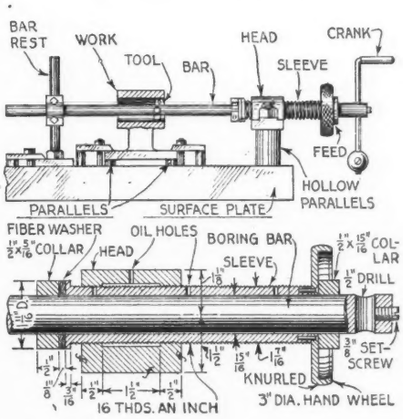
bored, counterbored, and threaded, as shown. The slots in the base of the block should be oblong to allow shifting the head when setting it up. The bore must be absolutely square to the outer surfaces, since all work is squared up from the faces.

This sleeve is bronze or brass, turned or threaded with 16 threads an inch. This part must be a free running fit through the threaded bore of the head. Adjustments are provided to take up any lost play.

The bore of the sleeve is exactly the size of the boring bars, plus a few thousandths for a neat turning fit. While the bar is rotated, the sleeve is either in a stationary position or moving forward in response to the turning of the feed handwheel. Two clamping collars locate the bar where required, and when a step forward is to be made, they are both loosened and the bar is then slid into its new position and the collars reset. As the forward collar must take most of the thrust, a fiber washer is used between it and the flange end of the sleeve. In order to make the action of the head as firm as possible, the head block is counter bored in the center, so that the threads have a bearing of only ½ in. at each end.

The bars are made of perfectly straight 15–16-in. cold rolled steel. When it is desired to use a small bar, the end of a bar is turned down, as shown. The tools are held in square slots, drilled and filed in the bar, and clamped in place either with wedges or setscrews.

A bar rest is made with a 4-in. disk of



How the boring bar is set up for use and a sectional view through the head

steel for a base and a standard of ⅞-in. round steel is used when the boring bar must be supported at the far end.

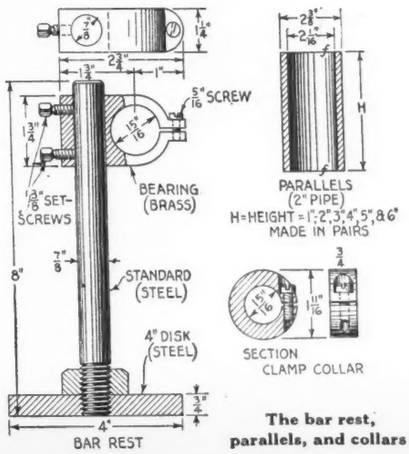
The drive bearing block is split and adjustable, and is so arranged that it slides and clamps in any position. In order to use the same block for small bores, bushings are made as required. They are split and a piece of thin, soft wood is forced into the split to make the bushings adjustable.

A Hand Crank Drives the Bar

The bar is driven by means of a hand crank made of ½-in. round steel. A thin brass sleeve is fitted to the handle end and is retained by a button head screw. Since a higher speed can be used when boring small holes, the crank is made adjustable and has an adjustable counter balance.

Since there is no vertical adjustment of the bar, it must be set at the right height, or the work must be adjusted to suit the bar. This can be done by using parallels, which, for use in the head, can be made of 2-in. pipe in pairs and graduated in length. The ends must be perfectly square. The bolts should be ½-in.—13 threads, and, when used in conjunction with a tapped hole workplate, are of the stud type, threaded at both ends.

To operate the bar, bolt the head as near to the workplate as possible, turn back the feed sleeve until the flange stops against the head. Then set up the job in front of the head, using parallels of the proper height, and square the work from one or more of the shaped surfaces of the head. The

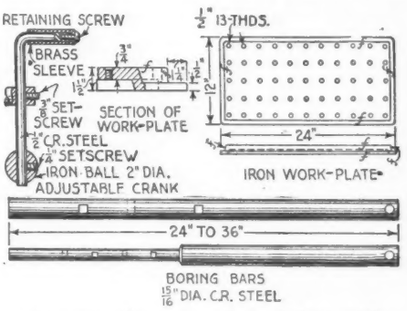


The bar rest, parallels, and collars

distance of the work away from the head is determined by the length of the bore and should be at least 3½-in., which is the travel of the feed sleeve. The bar rest is then placed in position and a surface gage used to check the height at each end. The bar is placed in position and fastened with clamp collars.

Round nose or diamond point tools with a single cutting edge are most used for horizontal boring, although it is advisable at times to finish a particularly fine hole with a square nosed tool. When boring long, deep holes, and if extreme accuracy is desired, it is advisable to finish the bore with a double cutter, after having first roughed out the hole to within a few thousandths of an inch of the finished size. When facing ends, a long piece of tool steel, ground perfectly flat and straight, is used, as also when counterboring to a square corner.

A handy attachment for the boring head consists of a 10-in. bar, fitted at the end with a No. 1 or No. 2 Morse taper socket, which can be used when drilling holes. When the machine is used for drilling, the



A serviceable type of workplate with tapped holes, and the adjustable crank and boring bars

work is held securely against an angle plate bolted to the worktable.

The boring bar can be used to good advantage on large, heavy work by mounting the head on an angle plate, which is mounted to the side of the casting that is to be bored. Because it is light in weight, simple in design and operation and easily carried about, the bar is a very useful portable tool for repair work.

Kerosene Overcomes Difficulties in Machining Aluminum

THE use of aluminum is greater today than ever, so that in the shop aluminum castings, plate and bar stock present quite a problem when it comes to machining them. If the tool is kept quite sharp, fair results may be obtained in turning the metal. Difficulty is experienced in drilling and tapping, however, because the more or less blunt cutting faces of the tools drag and tear the metal. The aluminum chips seem to have an affinity for the aluminum stock, and in backing out a tap it often happens that the thread is torn away.

Among the various cutting fluids, by far the best results, so far, have been obtained with kerosene used alone. For lathe turning the kerosene is fed in a fine stream over the tool. This gives a clean machined surface, apparently without much regard to the fineness of the tool edge. Similarly, when drilling and tapping, a plentiful supply of kerosene on the drill or tap assures keeping the hole or thread smooth and of the proper size.—S. L. F.

How to Make a Spider-Web Variometer

Tuning Unit Useful in Many Radio Circuits Does Away with Difficult Rotor and Stator Windings

By Edwin G. Gettins

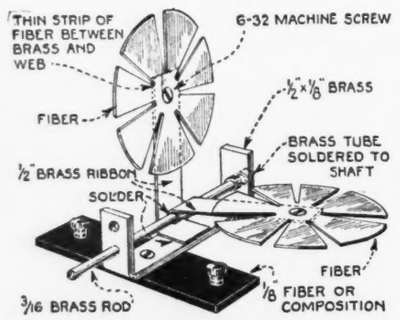
NEARLY every radio fan who has tried to make a variometer of the standard type has found difficulty in winding the concave rotor coil and in sticking the convex stator coil in place. Much easier to make is the spider-web variometer illustrated.

The main frame is ⅛ by ½-in. brass bent up at both ends. A hole is drilled through each end to accommodate a 3-16-in. shaft. At one end an extra hole is drilled for panel mounting.

The spider-webs are fastened to pieces of 1-64 by ½-in. brass ribbon by means of flat-head machine screws. A thin sheet of fiber or shellacked paper should be placed between the coil and the ribbon. One of the ribbons is bent and soldered to the base, while the other is bent around the shaft and soldered to it.

Two pieces of 3-16-in. inside diameter brass tubing should be soldered to the shaft at one end on both sides of the frame to keep the coils lined up. A small base of ⅛-in. fiber is fastened to the brass frame by a machine screw and the two binding posts are mounted on it.

The spider-webs used are fiber forms, cut as shown, and wound with No. 26 wire, but any conventional design of spider-web coils will serve. The outside wire from the stationary coil is fastened to one binding post and the inside terminal is connected by a piece of "pigtail" wire to the outside end of the movable coil. Using another "pigtail," fasten the inside end to the other binding post.



Method of mounting the coils, the wires being omitted for simplicity

This variometer also can be used as a two-circuit tuning coil by breaking the connection between the two coils and using one for the primary and the other for the secondary. As a variometer it may be used in any hookup where a standard type variometer is needed.

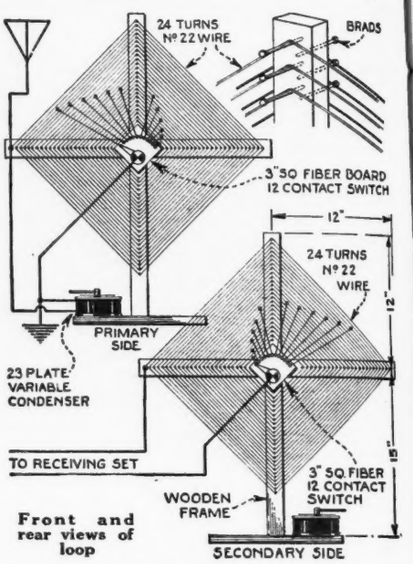
Laying Out Angles Quickly

EVER try to lay out an angle without a protractor? All you need is a scale and a pair of dividers. Strike an arc with a radius of 3.58 in. and every 1/16 in. on the arc will be very nearly one degree. For ordinary purposes the dividers may be set for a radius of 3 9/16 in. and the angle obtained will be close enough. —C. M. Wilcox.

Double Loop Tuner Cuts Down Radio Interference

IF YOU are using a single circuit radio receiver and are annoyed with interference from several broadcasting stations, the construction of the simple double loop illustrated will make your set much more selective. The device will work with either a crystal or a vacuum tube set.

Make a framework in the shape of a cross, by connecting three 12 in. and one 15 in. ends. The long end is nailed, screwed or otherwise mounted to a base block.



Front and rear views of loop

Drive brads or small nails every ⅜ in. along both sides of the arms to within 2½ in. of the center, as shown. The nails must not come directly opposite each other as they should not touch in the center.

Next wind No. 22 single or double cotton covered wire spirally on the nails on both sides, so that there is a continuous loop on each side. These loops are not connected in any way but both should turn in the same direction.

Cut two pieces of ⅛-in. fiber or composition 4 in. square and mount on them 12 taps, a switch arm and two binding posts. Fasten the switches to the center of the cross, using wooden spacers as necessary.

From one loop, which is to be the primary, take off leads, beginning at the outside, from the 2nd, 4th, 6th, 8th, 10th, 12th, 14th 16th, 18th, 20th, 22nd, and 24th turns, and solder to the switch points. Hook this loop to the aerial and ground, as shown, using a 23-plate variable condenser parallel with it.

The coil on the other side is a duplicate of the first but requires no condenser. It is connected to the aerial and ground binding posts of the receiving set.—G. L. S.

Sturdy Barrel Concrete Mixer is Motor-Driven

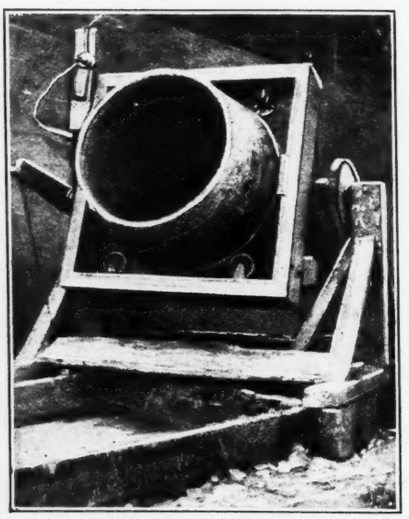
THIS concrete mixer, which gives dependable service, cost only $14 for materials, not including the motor.

A strong paint barrel, reinforced with an extra ½ by 2 in. hoop around it, about 4 in. from the middle, is used for holding the "mix." A flange with a ¾-in. shaft fixed to it is fastened to the head of the barrel with six bolts.

The shaft runs in a bearing in the swinging frame, as illustrated. The heavy hoop revolves on four 3⅜-in. casters attached to the square frame that surrounds the barrel.

The drive is provided by means of a Ford starting gear and pinion. The pinion is driven by the belt that goes around the corner to the common center from which the frame is swung. This arrangement permits the barrel to be turned over from end to end while it is still being rotated by the motor. The advantage in this lies in the fact that it can be loaded on one side and dumped on the other, as well as dumped from the same side on which it was loaded.

A ½-hp. motor pulls the load easily. About 12 or 15 large shovels of material seem to be the proper batch for one mixing. —E. W. Munson, Los Angeles, Calif.



The barrel revolves in a square frame that is pivoted and can be turned from end to end

The rear view of the mixer, showing the motor and arrangement of belts

Craftsman Gray Finish for Wood

OPEN grained woods, such as oak, chestnut, ash and gum, can be given a novelty finish in craftsman's gray with little difficulty.

Give the raw wood a coat of linseed oil and when that is dry dust out the pores of the grain thoroughly. Next fill the grain with white lead or a commercial paste filler colored a light gray. Force the thick filler into the grain with a putty knife and remove the surplus. When the filler is dry, sandpaper the surface with 00 paper and complete the finishing with wax or varnish.—E. L. V.

5 Room House $538

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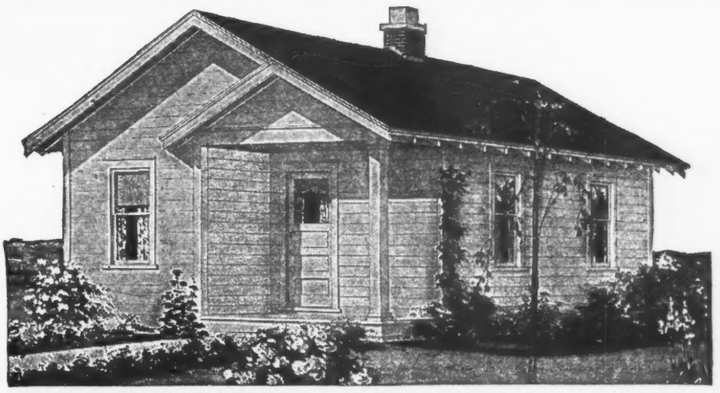

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This Dutch Colonial contains big living room, size 14 x 26 feet, dining room, kitchen, pantry, four fine corner bed rooms, bath and closets. All material is guaranteed to be cut accurately to fit. Quick construction, 18% saving of waste in material and about 30% saving on labor.

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The Origin of Speech and Writing

(*Continued from page 26*)

alphabet stands or is supposed to stand, for a very simple sound like "a" or "oh" or "s-s". Combinations of these sounds make up the syllables and words of the language. If we tried to write as the Babylonians did, with a separate sign for each of the sound combinations that we call a syllable, we would need 40,000 or 50,000 such signs instead of the 26 alphabetic signs that we find sufficient.

This, then, is the history of writing. It evolved, just as everything else has done. In the beginning it was a picture writing, each sign in it standing for a natural object or, more generally, for an idea.

Later on the signs were linked to single, spoken words and became word signs. Next they were syllable signs. Finally they came to stand for the simplest speech-sounds of all, the sounds that we call our vowels and consonants. Writing became alphabetic.

Chinese Still Use Idea Signs

There are, indeed, modern ways of writing still in use in the world that indicate some of the stages of this history. Chinese, for instance, is still written in idea-signs, just as the ancient Sumerian was. Each one of the curious looking drawings of Chinese writing was originally a picture; a picture of water or of a mountain or of a man or of some other familiar thing. These signs still stand for these ideas and only indirectly for the spoken words that correspond to them. A piece of Chinese writing will be read off in quite different *words* in different parts of China, just as the picture writing of the American Indians was. The written *idea*, of course, remains the same everywhere.

The simpler vowel and consonant signs that make up our modern alphabet originated, just as the syllable signs of the Babylonian writing had done, out of ancient pictures but they did not come exclusively, or even mainly, from the signs that were developed in Babylonia. For most of them we must thank that other great empire of the ancient world, Egypt.

At the same time that a picture writing was developing among the Sumerians—that is, about six or seven thousand years ago—a similar system of writing was growing up in Egypt. It was also a picture writing but the pictures used were different ones. It is the writing familiar to us as the signs called the hieroglyphics.

IN a comprehensive article next month, Doctor Free will sum up what he finds to be the accumulated proofs of science in support of the theory of evolution.

The evolution of these picture signs was the same in Egypt as in Babylonia. They became word signs, then syllable signs; finally some of the Egyptian signs became almost if not quite alphabetic.

At the same time the shapes of the hieroglyphic signs underwent a change. They were complicated and difficult to draw. Though they were retained in the full original complexity in religious texts and on official monuments, there gradually developed for daily use a simpler modification of them, a sort of running hand that could be written easily on the paper-like sheets which the Egyptians had learned to make out of the papyrus plant, a kind of rush-like weed that grew wild along the banks of the Nile. It seems to have been this everyday handwriting of the Egyptians that led, in the main, to our modern alphabet.

The people who devised it for us were the Phoenicians. In the centuries between 2000 and 1500 B. C. there grew up on the coast of what was to be later on the Holy Land, two great Phoenician cities, Tyre and Sidon. The people of these cities were ship-owners and traders. They carried the ocean commerce of the great land powers, Babylonia and Egypt. They were familiar, by necessity, with the written languages of these countries.

And so they borrowed from the Egyptian running hand, and perhaps from the Babylonia syllable signs also, a series of marks which they seem to have used, at first, as marks for their bales and boxes of merchandise, as we use "O. K." or "$".

Soon these marks were being used as sound-signs to write the Phoenician language. Presently the Greeks learned them from the Phoenicians and used them to write Greek. The Romans modified these same signs so that they could use them to write Latin. These Roman letters are our own.

Since the days of the Romans there has been almost no change in the alphabet or in ways of writing. The invention of printing has tended, on the whole, to petrify both writing and speech and to keep them from changing much or rapidly.

But one invention that has grown out of printing constitutes, curiously enough, a return to the oldest writing methods of all. This invention is the picture book, the illustrated magazine and newspaper. What is the picture section of the Sunday paper, for instance, but a kind of picture writing quite like that of the Indians or Babylonians?

There are interesting social possibilities in the growing use of such printed pictures and of the related invention of motion pictures. Diversity of speech is admittedly one of the greatest obstacles to that international sympathy and understanding which is so essential, the sociologists insist, to the future security of the world. That is why so many able and forward-looking men are devoting time and money to develop an international speech like Esperanto.

An International Picture Language?

Such a common speech for all the world is greatly to be desired and is presumably inevitable, but it seems to arrive slowly. Meanwhile, is it not possible that we are developing, all unawares, an international language of pictures?

Writing is evolving, speech is evolving, civilization is evolving; perhaps even man himself is evolving. The key to knowledge of what may happen in the future lies in the study of what has happened in the past.

For Further Reading

ON the nature of language and the origin of speech the best work is still "The Science of Language" by F. Max Müller, Sixth Edition,1871. Many reprints have been issued, the latest being by Longmans, Green & Co., New York, in the complete edition of Professor Müller's works. On the history of writing see "The Story of the Alphabet," by Edward Clodd, D. Appleton and Co., New York, 1915. On the origin of the Indo-European group of languages of which English belongs see "The Home of the Indo-Europeans," by Harold H. Bender, Princeton University Press, Princeton, N. J., 1922. A recent work on the nature of language, authoritative but somewhat heavy reading, is "Language," by Edward Sapir, Harcourt, Brace and Co., New York, 1921.

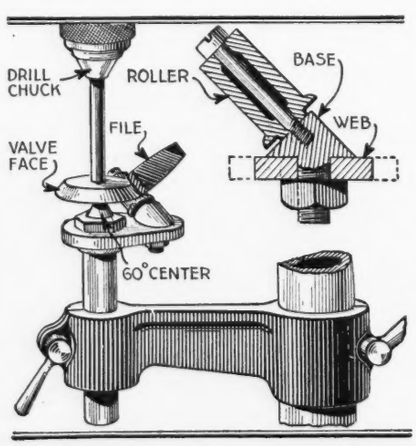
On request, the author will supply the names of other books on the subject.

Valve Filing Fixture Saves Time of Auto Mechanics

WHEN grinding in a set of valves, many automobile mechanics first dress down the worn and pitted surface of each valve by filing it. The valve stem is held in the chuck of a sensitive drill press and revolved against the file, which is kept approximately at an angle of 45 degrees to the stem. While this is a speedy method so far as the filing is concerned, the accuracy of the angle is often lost and the actual grinding operation takes longer.

A better method is to use a simple attachment, as shown, to control with precision the angle of the file. By keeping the file against the guide roller and down on its flange a perfect job is made of filing the valve and only a little grinding is required to finish the surface.

A piece of steel is turned to fit the hole in the table arm of the press and a flange is left near one end to support the web, which is retained in place by a locknut, as indicated. The small portion of the shank that projects beyond the locknut is turned to form a 60-degree center and the point is case hardened. The web is ¼ in. thick steel stock drilled to slip over the upper part of the shank.



The valve filing fixture in use and a cross section showing how the roller guide is mounted

A roller ⅝ in. in diameter is set on a base that holds it at an angle of 45 degrees to the valve stem, and at the same time at right angles to a line or lines tangent to the roller and valve at the points where the file is in contact with each.

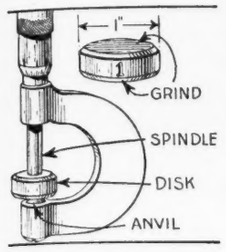
In use, place the valve in the drill chuck and elevate and clamp the spindle as high as possible. The fixture is then slipped in the hole in the table arm and is elevated to bring the center point snugly up into the center hole in the head of the valve. The file is used with a stroke, as on lathe work.

A striking advantage of this fixture, besides its simplicity, is that it will take care of valves of all sizes.—J. V.

BETTER SHOP METHODS

Keeping Your Micrometer True With Three Lapping Disks

CONSTANT use of a micrometer results in the edges of the anvil and the end of the spindle becoming slightly rounded. This wear can be corrected most accurately by the use of three cast iron lapping disks, one .275 in. thick, another .283 in. thick, and a third .291 in. thick. All may be 1 in. in diameter and the edges should be beveled. They should be stamped 1, 2, and 3 for ready identification.

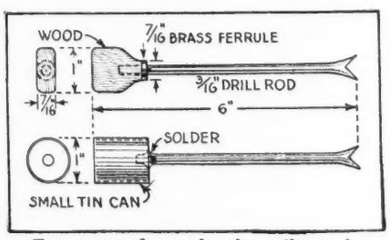


The spindle and anvil are lapped perfectly square

As one complete turn of a micrometer screw means an advance or retreat of .025 in., the three disks together make it possible to lap the faces evenly and squarely. Charge the blocks by rubbing them on a surface plate that has been charged with a little flour emery. Bring the spindle down on one of the blocks, as shown, and rub with an easy, circular motion. Do the same with the second and third block, lapping an equal amount with each. These blocks, make it easy to keep the micrometer in good condition.—H. S.

Sound Magnifier for Lapping

IN WORKING with a diamond lap it is desirable to know just when the lap is in contact with the work. This often requires more than a keen sense of touch. By placing on the work the forked end of the

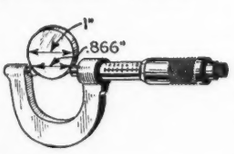


Two types of sound rods easily made

tool illustrated and putting an ear to the other end, the sound of the lapping process will be magnified greatly and the slightest contact will be audible. The instrument can also be used in grinding or milling.—S. L.

Dividing Cylindrical Work

TO SPACE equal distances around cylindrical work accurately, a micrometer may be used, as shown, in connection with the table found in any mechanical handbook giving the length of a side of any regular polygon inscribed in a circle.



If, for instance, it is desired to divide a 1-in. cylinder into three parts, a starting point is scribed, then the micrometer is set at .866, given in the table as the length of the side of a regular triangle where the diameter of the inclosing circle equals 1. If the cylinder were 3 in. in diameter, it would be necessary simply to multiply .866 by 3.—L. C. M.

A sure test for a worn and scored cylinder
The STARRETT CYLINDER GAGE

no wonder she won't pull!

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NOW you can KNOW when your cylinders are scored, tapered or out-of-round. Ask the shop to test them with the Starrett Cylinder Gage. Slide this Gage up and down the cylinder *yourself* and prove to your own satisfaction whether your cylinders need attention.

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This new Starrett Cylinder Gage will help you sell more service. No more difficulty in convincing the car owner the necessity of truing up worn cylinders. No. 452 is designed on an entirely new principle—non-collapsible, easy to read and wonderfully accurate.

Revised Supplement to Catalog No. 22 "W" describes this new instrument. Write for free copy.

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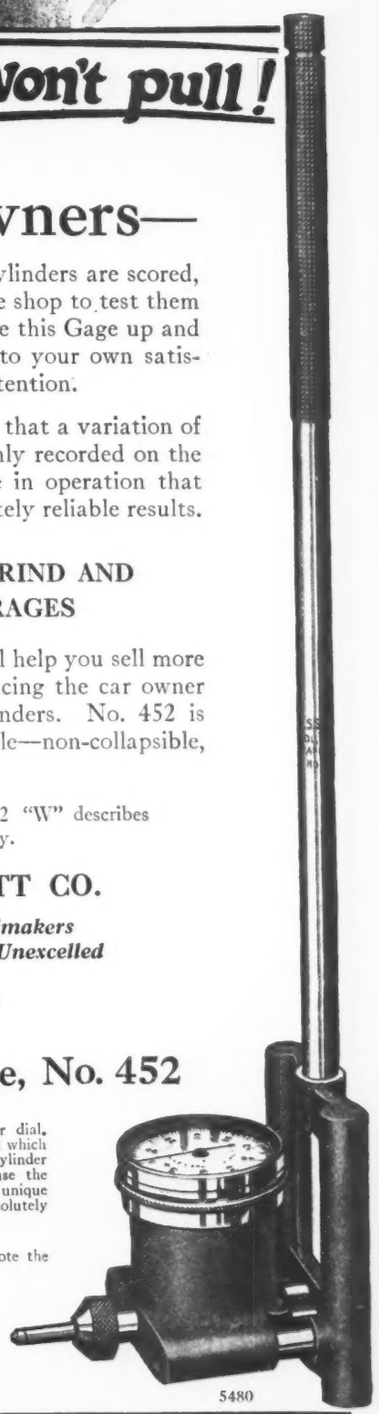
Of rugged construction—has non-breakable crystal over dial. Latter is mounted on block moving at right angles to sled which has two line contact points always in alignment with the cylinder walls. Two hardened contact points *independently* cause the hand to travel over the dial (reading in .001") and with a unique double spring action make the gage self-centering and absolutely non-collapsible.

After the variation of the bore has been determined, note the reading on the dial and transfer to an outside micrometer to find the diameter.

Two adjustable rods which can be carried in the hollow handle provide for diameters ranging from 2½ to 6 inches. Gage is nickle plated. Weight, 12 ounces.



5480

Use Starrett Tools

The Clipper your barber uses

ASK your barber what kind of clippers he uses and he will undoubtedly answer "Brown & Sharpe."

For he has found that day-by-day, year in and year out, these clippers cut smoothly and accurately. They stay sharp. Some barbers are using today the Brown & Sharpe clippers they bought twenty years ago.

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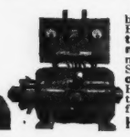

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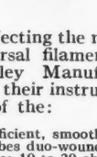

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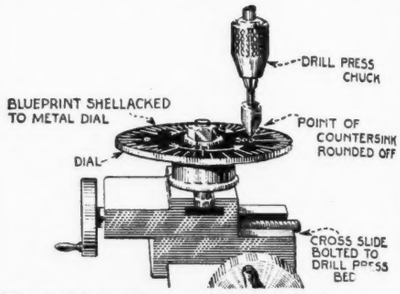
BETTER SHOP METHODS

Engraving and Lettering with the Drill Press

IN MAKING up two special dials for an engine control it was necessary to finish the faces with engraved lines and letters, for which full size blueprints were furnished. To do the engraving as quickly as possible with the equipment at hand, an ordinary drill press was used.

The blueprints were cut out and fastened to the dials with shellac. A cross slide from a bench lathe was bolted to the bed of a


DRILL PRESS CHUCK
BLUEPRINT SHELLACKED TO METAL DIAL
POINT OF COUNTERSINK ROUNDED OFF
DIAL
CROSS SLIDE BOLTED TO DRILL PRESS BED

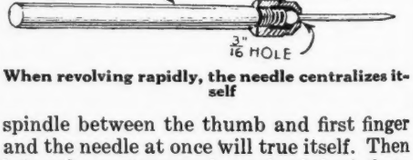
The dial, bolted to a small cross slide, is engraved with a modified countersink

small drill press and one of the dials was fastened to the cross slide with a T bolt in the slot. A suitable tool was made by rounding off the end of a countersinking point, at the same time retaining the cutting edges. This was placed in the drill chuck and, after the proper depth for the cut had been determined, the drill stop was set at the point. By using the two feeds of the lathe cross slide, the engraving was quickly and easily accomplished, the tool being lifted only to pass from one line to another.—G. A. LUERS.

Tool for Locating Centers

WHEN the spindle or chuck on a milling machine runs out of true while drilling or boring holes, the simple tool illustrated is useful for quickly centralizing the hole.

Catch the spindle in the chuck and let it run at a high speed. Take the point of the

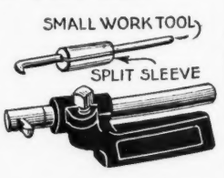


When revolving rapidly, the needle centralizes itself

spindle between the thumb and first finger and the needle at once will true itself. Then bring the center punch mark of the hole to a line with the needle point. I made this device several years ago and have used it ever since with great success.—J. A.

Bushing Adapts Boring Tool Holder for Drill Rod

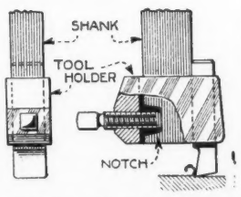
A SPLIT bushing made as shown to fit a standard boring tool holder is a useful addition to the tool equipment. It allows a drill rod to be used for small boring and inside threading jobs on the lathe. The utility and convenience of drill rod for making such small tools is well known.—E. W. BURNETT, Ottumwa, Ia.



BETTER SHOP METHODS

Tool Holder Aids in Producing Perfect Shaper Work

DIFFICULTIES experienced in obtaining perfectly true and flat surfaces on a planer- or shaper-tooled job are often due to poorly designed or wrongly used tool holders. When the tool is held in a rear position, as illustrated, there is less likelihood of chattering.

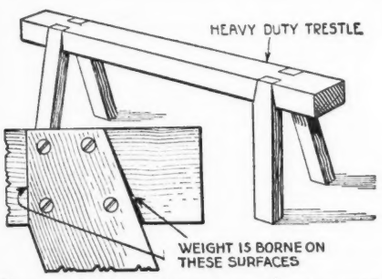


Details of holder that clamps tools so as to avoid chattering

The tool holder shank is made of stiff machinery steel, shaped and notched for the setscrew. The clamp head fits over the shank and the tool is held rigidly and firmly against the back face of the shank. This aids in obtaining perfectly flat and true surfaces.—V. R.

Building Strong Wooden Trestles

WOODEN trestles or sawhorses are often made, even by experienced carpenters, so that the weight is borne mainly by the nails that hold the legs to the cross beams. A better method is to bevel off the inside edge of each leg at the top, as shown, and make a notch of corresponding

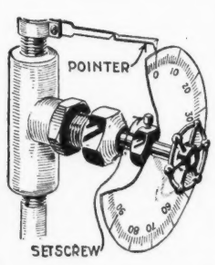


These wedge-like joints are an improvement over the usual method of making sawhorses

shape in the cross beams. The joint is then wedge-like in principle and the weight is sustained largely upon the wooden surfaces of the joint and only to a minor degree by the nails or screws used to hold the joint together.—S. B. O.

Dial Aids in Setting Expansion Valve Accurately

THE dial illustrated has proved exceedingly useful in setting the expansion valves in a storage plant. It would also be valuable on any valve where close and accurate setting is required.



How the dial is attached

The 5½-in. dial is cut from tin. A blank nut is drilled and tapped for a setscrew and then soldered to the dial. The face is painted with white enamel and divisions put in with waterproof drawing ink. The face can then be given a coat of shellac, although that was not done in this particular case.

The pointer is sheet brass, fastened with a stove bolt.—ARTHUR M. SAMP.

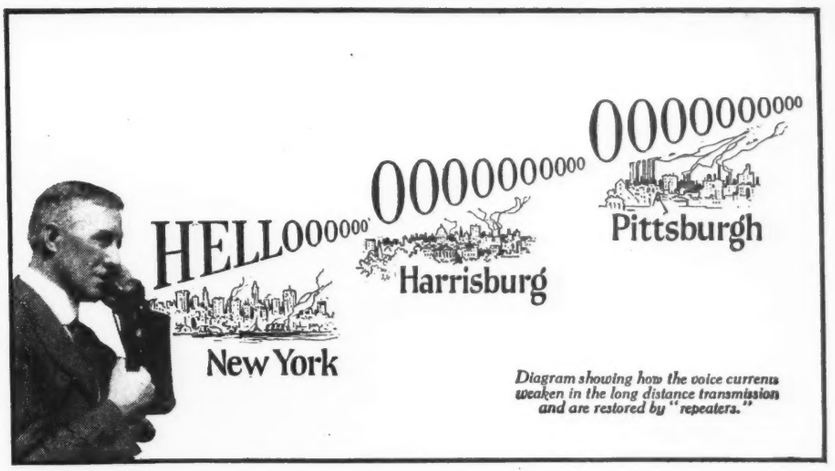


Diagram showing how the voice currents weaken in the long distance transmission and are restored by "repeaters."

Mastering Nature's Forces

Without the telephone "repeater," the entire electrical power available on the earth would not be sufficient to make trans-continental speech commercially possible. The three thousand repeaters now in use on Bell System long distance lines have increased the talking range of every telephone by thousands of miles. By making possible the use of smaller gauge wires, repeaters have kept down the cost of equipment by millions of dollars.

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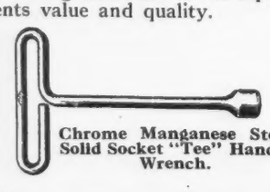

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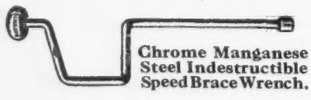

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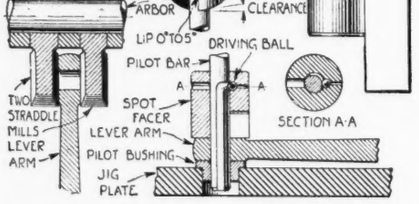
BETTER SHOP METHODS

Spot Facing *Versus* Straddle Milling

SPOT facing is a method of removing metal with what we might term a flat-bottom drill tool having multiple cutting edges. It is one of the quickest and cheapest ways to remove metal and should be used wherever the requirements of accuracy are not too exacting. When work is planned in the shop, preference should be given to spot facing over straddle milling.

Straddle mills are expensive tools to make and maintain, and spot facers can be made for a fraction of their cost. Spot facers can be sharpened by the machine operator himself. By making use of a relatively cheap machine like the drill press, spot facing leaves the miller open for more important work and saves in the labor cost of a high priced mechanic.



Contrast between the methods shows why spot facing is usually cheaper

The favorite spot facer is the two flute type, demountable on the pilot. The pilot is made of stub steel, with a flat and groove milled as shown and hardened and ground to size. The pilot bars can be fitted to quick change collet fixtures or held with a taper shank or in a drill chuck.

The spot facer is made of a good hardening steel. The stock is chucked in a lathe, drilled, bored and reamed, and then removed to the bench, where the two flutes are sawed and filed to shape. If desired, the flutes can readily be milled on the blank. The driving is done by a ball bearing pressed into a drilled hole. The ball slips over the flat of the pilot bar and engages a horizontal groove, which tapers from the depth of the flat to nothing.

In sharpening a spot facer of this type, it is removed from its pilot bar and the two cutting edges are brought in contact with a fine and smooth grained emery wheel. The clearance angle is about 7 degrees. A square is used for checking up the parallelism of the two flat cutting edges.

The circular faces of rods, connecting rods, and many parts of automobiles and machinery can be surfaced to advantage with the spot facing method. The parts are first drilled and reamed in the usual way, and are then set up on the drill press on a special, although simple, fixture. The stops of the drill-press spindle are set for controling the depth of facing for the proper depth. Provided the work has a wide tolerance limit, it can be rushed out quickly—L.D.J.

Rotary Tools Increase Speed

(*Continued from page 79*)

is a locking lever having a tooth on its inner edge and a diamond-shaped raised cam portion on its outer side. Directly back of this lever is a spring pin operated by a spring, the tension of which may be varied by means of an adjusting screw, the whole being housed in a built-out portion of the shaft bearing.

In normal idle position, the tooth of the lock lever is held in engagement with the locking disk by spring pin. When the press is tripped and the punch descends, the swing lever swings outward when its lower pin strikes the raised cam portion of the lock lever. After the punch reaches its lowest point, the swing lever swings under the cam portion of its own weight, as far as its stop pin allows.

Die-Holder Turns Automatically

The hook lever is of such a length that its hook portion is ⅜ in. below the ratchet tooth. As the punch ascends, the lower pin in the swing lever, coming in contact with cam portion of lock lever, forces the latter out of engagement with the locking disk and holds it for the next ½ in. of the upward stroke. As soon as the locking lever is forced out of mesh with the disk, the hook lever engages with a ratchet tooth and causes the die-holder drum to revolve one eighth of a turn on the rest of the upward stroke.

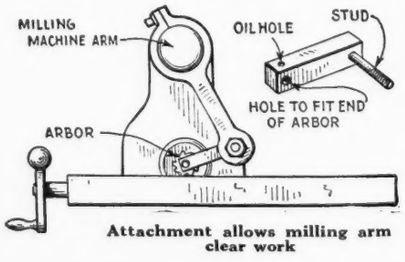
The lower pin in the swing lever leaves the cam portion of the locking lever as it ascends, thus allowing the spring pin to force the locking lever against the locking disk and into engagement with it as it comes into position. In this way the various steps follow each other smoothly and with great precision.

Since the work is automatically ejected by gravity, the operator has only to place the work in the dies as they are brought into loading position.

The same principle may be readily embodied in tools constructed to perform other punch press operations of somewhat similar character.

Milling in Awkward Places

MACHINISTS are sometimes confronted with a milling operation where the small size of the cutter or the depth of the cut and shape of the work is such that the pendant arm of the mill has not sufficient clearance. This difficulty is often overcome by using the auxiliary device illustrated. It is made of cold rolled steel about 1 in. square and 7 in. long. A hole to fit the end of the arbor is drilled near one end, and a stud that is small enough to fit the arm is fastened to the other end. This allows the arm to be placed on one side so as to clear the work. I have used this method many times in my work with good results.—F. N.



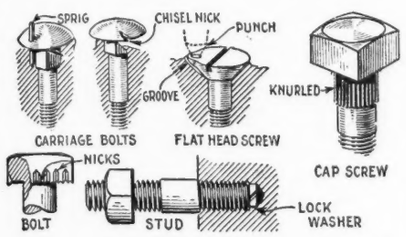
Attachment allows milling arm clear work

BETTER SHOP METHODS

To Prevent Screws and Bolt Heads from Turning

IN REPAIRING or assembling machinery there is nothing more provoking than to have a screw or bolt turn while tightening the nut. This difficulty can be overcome in various ways.

The weaving of the frame of an automobile will often cause the carriage bolts to wear so large a hole that the square shank will no longer keep the bolt from turning. To make the head hold, either drill a small hole for a sprig or cut a slanting gash into the edge of the head, as shown. The gashing method is quicker but calls for a sharp



Quick ways to lock the heads of screws and bolt heads when they tend to turn too freely

chisel, the cut throwing one edge of the nick down and the other up.

In the case of a flat head screw, chip a tiny groove in the countersunk hole for the head, put in the screw with a light punch, and hammer the head of the screw so that a burr will be cast into the groove. This serves as a key to prevent the head from turning.

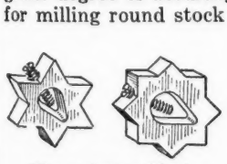
A neat method for making a cap screw tight is to knurl the body of the screw immediately beneath the head.

Rough forged bolts used on agricultural machinery can be made to offer some resistance to turning by nicking the head of the bolt on the under side, as indicated, to act as spurs.

To make a stud stay put, drop a lock washer into the hole before screwing it in. This will engage and hold the bottom of the stud when it is screwed home. This is a particularly simple expedient and yet one not often used.—E. M. D.

Blocks for Indexing in Vise

TO SAVE the time necessary to set up a dividing head and tail center, the indexing blocks shown can often be used for indexing on work that requires no very great degree of accuracy. They are useful for milling round stock square at the end, milling opposite sides of a round piece flat, milling flutes in reamers, and the like.



The indexing blocks

The block needed to give the required number of sides is clamped to the end of the work and one of the faces is set level with an indicator surface gage. When the first cut has been made, the work is turned in the vise until the next face of the block that is to be used for indexing is level.—C. D. R.

Holding Cylindrical Work

TWO FLAT files often can be used to advantage in holding delicate cylindrical pieces in a bench vise. They will hold the work with fair tenacity without marring to the extent of the usual coarse pipe jaws.—C. M. Wilcox

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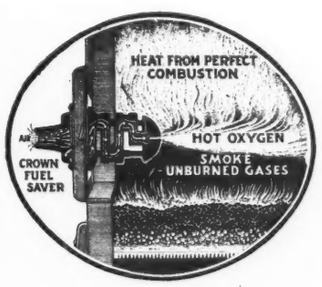

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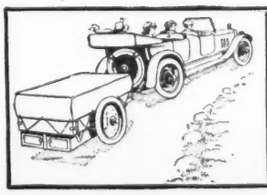

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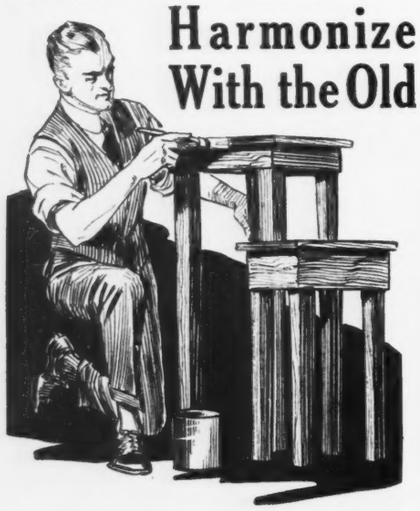

SMALL odd pieces of modern furniture add greatly to the attractiveness of every home. You, yourself, can easily make them for your family. There is no particular trick to constructing porch swings, tables, telephone sets, etc. You can give your work a beautiful finish with

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How to Color Parchment Shades

By R. Franklin Mundorff

THERE are not many home decorations that reflect charm and individuality more than fine lamps with parchment shades. To make the shades requires no great artistic skill if only simple designs are attempted, and, expensive as the shades are when purchased, the cost of making them is really very small.

Patterns may be adapted from designs on old china, cretonne, brocade, wallpaper or lace. Ready-made patterns, either of the perforated or the hot-iron variety, may be used, as well as embroidery designs and stencils.

Real parchment or vellum is very expensive and most commercial shades and practically all made by amateurs are of heavy watercolor paper. The only other materials necessary are raw linseed oil, turpentine, white shellac, an assortment of large and small brushes, artists' oil colors in tubes, and old linen rags.

Three beautiful lamps

To make a shade, thumbtack the water color paper to a drawing-board, mix equal parts of linseed oil and turpentine in a saucer, fasten the linen rags to a stick to form a swab, or make a wad for holding in the hand, dip the cloth into the turpentine and oil, and apply to the surface of the paper with a light rotary movement until the entire surface has been covered. Next rub the mixture on the other side of the paper, alternating the treatment, until three or four coats have been applied. Then hang the paper up to dry.

If after twenty-four hours the sheet still looks papery, repeat the treatment once or twice. By changing the proportions of the oil and turpentine it is possible to make the mottling either coarser or finer.

If a plain shade is desired, the next step is to rub in the color. Squeeze the color on a palette or piece of glass, and mix it with a little turpentine. The color is applied by pouncing it on with a linen wad. By mottling several colors over the surface or by blending light and dark shades with the linen pounce, charming results can be obtained. Hold the paper before the light at intervals to make certain that the color is even. After the paint has dried, repeat the process on the other side.

When fairly light colors are used for the outside, orange or rose will often prove most effective for the inside. Care must be used in selecting the colors, for a blue shade lined with red will appear purple or, lined with yellow, it will seem green when the light is shining through.

An effective finish can be produced by applying stripes of black or some contrasting color at the top and bottom. These stripes can be sketched with a string and pencil at the time the pattern of the shade is being drawn, which is done after the body color has become dry.

In many instances, especially when making shades in pairs, a pattern will have to be made. To make pattern fasten a piece of heavy wrapping paper securely to the board, drive a small nail in the center, and tie a string to it. Fasten the free end of the string to a pencil and, holding the pencil in an upright position, swing it in a wide circle, keeping the string tight. By lengthening the string draw another circle so that the distance from the first line to the point where the pencil now touches the paper is equal to the height desired for the shade. Cut out and overlap the ends until the shade is the correct size, and then trim off one end, allowing for a ½-inch lap. The greater the distance of the pencil from the center and the larger the circles described, the straighter will be the side of the shades.

Another easy method is to buy a wire frame of the shape and size desired and paint the top and bottom rings of the frame and one upright wire with black paint. Roll the frame on the pattern paper until it has started to register the second time. Allow ½ in. for overlapping and cut out the pattern. Cut away the wire uprights, as the top and bottom rings are all that are usually required for mounting a parchment shade.

If the shade is to be decorated, the paper is oiled and dried, and the pattern of both shade and design are drawn in. The design must be painted before rubbing in the background, as otherwise the colors are apt to be muddy, except when the background is cream, pale gray, or a delicate tan or light rose.

A novel parchment shade

After the design has been painted in and become dry, work in the background with the linen wad as close to the design as possible and paint in the remainder with a brush. The lining color should be applied in like manner, taking equal care not to run over the design, as this would muddy the colors when the lamp was lighted

(*Continued on page 91*)

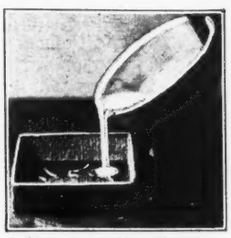
THE HOME WORKSHOP

How to Cast Small Objects Directly in Metal

By Dr. Ernest Bade

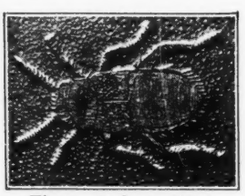
BY USING a silvery white, slow melting alloy, it is possible to obtain direct casts or impressions of woodcuts, coins, medals, medallions, engravings and the like without injury to the objects.

The alloy used is not influenced by atmospheric changes, and it can be bent, hammered, turned, and cut with a knife, as well as used for soldering tin, lead, and nickel. It consists of tin, lead, bismuth, and cadmium. The simplest method to prepare it is to heat 3 parts, by weight, of cadmium, 4 parts of tin, 8 parts of lead, and 15 parts of bismuth. Melt the tin (which is the metal of the lowest fusing point) first and then add the bismuth, cadmium, and lead one by one, stirring constantly with a glass rod or a splinter of wood.



Pouring the fused metal on a book cover ornament

When all have fused together, remove the alloy immediately from the fire and continue stirring in order to prevent the heavier metals from settling at the bottom. Do this until the contents of the crucible solidifies.



The metal casting shows even the finest details

This alloy softens in a temperature at 140° F. and fuses directly at 158° F. Therefore, a fragment dropped into a test tube of boiling water melts instantly. This peculiar property allows the taking of impressions of such delicate structures as leaves, parts of plants, wings of insects, and the like. Such casts are often very beautiful and can be used as paper weights and for a variety of ornamental purposes. Casts also make inlays for metal craftwork.

How to Color Parchment Shades

(*Continued from page 90*)

The shades are finished after becoming thoroughly dry by applying clear shellac thinned half and half with denatured alcohol. Six or eight coats of shellac can be applied, the shellac being rubbed in the same manner that the oil was put on. If a lacquered effect is desired, this may be obtained by using heavier coats of shellac and rubbing down between coats with powdered rottenstone and linseed oil.

When the pattern has been cut out, bind the lapped ends together with small brass paper fasteners and glue the space between. Sew the shade to the wire rings at top and bottom with heavy cotton thread and finish by binding with flat gold or silk braid of a harmonizing color.

CELLULOID lights in auto curtain can be cleaned readily with vinegar applied on a piece of muslin or cheesecloth.

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The Amazing Discovery That Cuts Oil Bills 33⅓% to 50%!

Now you can try this remarkable new invention on your Ford for 10 days at our expense. Send no money. Simply mail the coupon below

Here is a new scientific discovery that every man who understands a Ford motor instantly appreciates. It is called AUTOVAC—and it is the invention of P. W. Craig—Motor Specialist.

What it accomplishes is scarcely believable—until you have actually seen it work.

The first and most obvious thing that AUTOVAC does is to cut your oil consumption 33⅓% to 50%. It pays for itself 5 to 6 times a year in oil savings alone. But AUTOVAC does far more than this.

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At the present time dust and grit-laden air is constantly being drawn into the crank-case of your motor. This grit acts like an emery, grinding out the bearings. AUTOVAC stops this grit from being drawn into the crank-case! Now for the first time you can feed your motor oil that is really CLEAN. And clean oil means an infinitely smoother-running motor—and longer engine life.

By stopping the oil from passing from the piston rings to the spark plugs AUTOVAC eliminates the cause of mis-firing.

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AUTOVAC takes the place of the oil-filler plug in the crank-case of your car. It creates a partial vacuum which sucks the oil in—absolutely preventing oil leakage in the joints and bearings.

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1. That Autovac will cut your oil consumption 33⅓ to 50%
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You install it yourself in two hours. Goes through any door, fits any basement, burns practically any fuel. Gives marvelous heat—and saves you money. $10 down: $10 a month.

Write! Old fashioned stoves and worn out furnaces waste money! Let the Bulldog cut down your fuel bills. Write for free book TODAY!

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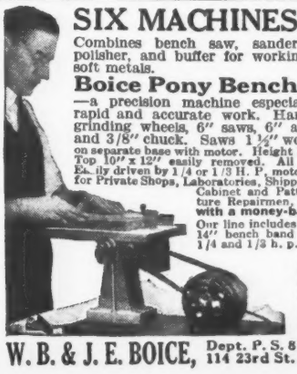
$10 Puts It In Your Home



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Boice Pony Bench Machine

—a precision machine especially adapted to rapid and accurate work. Handles 4" and 5" grinding wheels, 6" saws, 6" and 8" sand disc and 3/8" chuck. Saws 1½" wood. Mountable on separate base with motor. Height 10". Weight 31 lbs. Top 10" x 12" easily removed. All metal construction. Easily driven by 1/4 or 1/3 H. P. motor. Especially suited for Private Shops, Laboratories, Shipping Depts., Printers, Cabinet and Pattern Makers, Furniture Repairmen, etc. **Machine sold with a money-back guarantee.**

Our line includes 4" bench jointers, 14" bench band saws, bench drills, 1/4 and 1/3 h. p. ball-bearing motors and larger motor driven bench saws. Write for descriptive literature and prices on Boice Pony Bench Machine and the above Boice-Built Bench Machines and Motors.

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They are cast in one piece of electric furnace steel with hollow spokes and rims. They give Strength — Light Weight — Durability—Tire Economy—Accessibility —Handsome Appearance.

$1000 in Cash Prizes

THERE are more than 1,000,000 motor trucks in the United States and Canada.

More than 1,000,000 men are grappling daily with the *practical* problems of economical motor transportation.

We want *their* ideas. We want *their* suggestions.

And we are willing to pay $1000.00 to get them.

As the world's largest manufacturers of steel truck wheels, we are benefited by anything that benefits the motor truck industry.

Open to Truck Drivers and Fleet Owners Only

Therefore we have offered $1000.00 in cash in a Prize Contest that is open to every driver of a truck of two-tons or greater capacity whose employers have five or more such trucks.

Cash Prizes will be awarded for the best practical suggestion and ideas for reducing operating costs in motor transportation.

Show this advertisement to some truck driver whom you know. It does not cost him or his employer anything to enter this contest. There is absolutely no obligation.

Get blanks and instructions today

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The Contest Committee

The Dayton Steel Foundry Co.

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Dayton Steel Truck Wheels

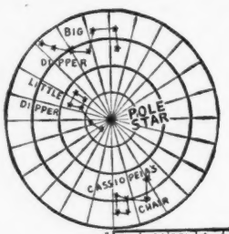
THE HOME WORKSHOP

Easily Made Perpetual Star Map

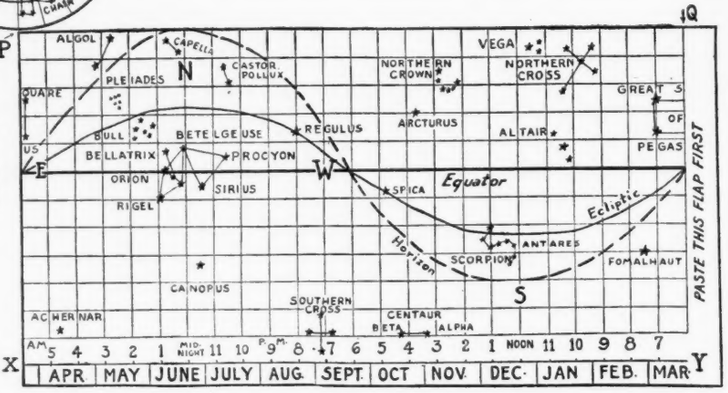
By Richard C. Moulton

CAN you name the bright stars visible these fine summer evenings? It is not easy to do without a good map, but flat star maps are somewhat difficult to use, and globes are expensive. It is, however, a simple matter to make an excellent substitute for a globe map.

A large cylindrical pasteboard carton, the taller the better, is the necessary foundation. Draw a circle the size of the end of the carton, on a piece of writing paper, and by lines through the center divide it into 24 parts. An easy way to do it is to lay a watch in the center of the circle and mark off points for the 12 hours; then insert half way points. Divide one of the rays thus drawn into four



Pasted on a cylinder, these diagrams serve as a key to the more important stars and constellations



rectangle and rule the 25 vertical lines shown, the twenty-fifth of which, at *P*, should fit the first, at *Q*, when you later paste the rectangle on the carton. Then draw the horizontal lines that, like the circles previously drawn, represent intervals of ten degrees of distance from the Pole star.

The equator should be represented by a heavier line, or by one of a different color. With the help of the two sets of lines, copy the stars and their names as indicated with the following exceptions: omit the "horizon" (the curved line of dashes), the large letters E, N, W, S, and the line of hours immediately below Achernar.

Before you paste the rectangle on the carton, cut out a rectangle of similar size from extra stout paper, and trim it so that its upper boundary will follow the curved line of dashes and its lower edge will be the line *X*—*Y*. This piece will be called the shield. On the shield copy the things you omitted from the rectangle, and also the portion of the equator line from E to W.

Now paste the rectangle on the carton, taking care that the lines at *P* and *Q* come together opposite the end of the ray marked with the arrow just above *P*. Then wrap the shield round the carton, but not too tightly, and paste the end *E*—*X* to the flap at the other end.

If you can slip the shield round freely on the cylinder, your star map is ready for use. You will find it accurate enough if you live between 35° and 45° N. If you live as far south as 30°, set the curve on the shield so that it reaches one square

(*Turn to page 93*)

equal parts and draw the three concentric circles as shown.

The circles represent distances of 10, 20, 30, and 40 degrees from the Pole star, and the rays show how much the firmament seems to turn in each of the 24 hours of the day. By the aid of the lines, copy the constellations, Cassiopeia's Chair, the Big Dipper, and the Little Dipper, shown within the circle.

Then cut around the outer circle and paste the disk on the end of the cylinder. Next, wrap a sheet of drawing paper round the carton and mark where each of the 24 rays meets the upper edge of it—on the line marked *P*—*Q*. Flatten out the paper

Invaluable New Radio Service Begins in Home Workshop Next Month

TO AID readers who wish to build their own radio sets, POPULAR SCIENCE MONTHLY has established an experimental radio workshop in New York. Here a series of splendid radio sets is being developed under the personal supervision of Mr. Joseph Calcaterra, Radio Information Editor.

The first of these sets is now ready—a compact, highly efficient Flewelling-circuit receiving set, such as is described in Mr. Jack Binns' article in this issue. Photographs of the set and full instructions for building it will appear in the Home Workshop next month.

In the case of the Flewelling and other sets that are being built, no expense or pains is being spared to make the construction as simple, foolproof, and reasonable in cost as possible. Experiment after experiment is being made, and each article will be the last word in "how to make" radio material, for which POPULAR SCIENCE MONTHLY already has so wide a reputation.

If you are interested in radio, you cannot afford to miss one of these articles.

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Why these blades do not break

ATKINS AAA Non-Breakable Hack Saw Blades are made of selected steels, hardened and tempered by an exclusive gas and oil process which makes the cutting edge extremely hard and the back unusually tough and flexible.

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You can reduce your metal cutting costs and avoid losses due to blade breakage by using Atkins Hack Saw Blades. Let us prove it. Tell us what metal you cut, enclose ten cents and we'll send you a sample blade that will give you remarkable cutting results.

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No matter what wood or metal-cutting you do, there are Atkins Saws to save you time, labor and money. Ask for our free booklets on the saws you're interested in.

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A 32 page book that's full of practical suggestions on metal-cutting, and general shop information. Every man who buys or uses saws will find it helpful. Send for it NOW. Just write your name and address on the margin of this page and mail it to us.

Do It Now

E. C. ATKINS & CO., Inc.,
Dept. D-20, INDIANAPOLIS, IND.
Makers of "Silver Steel" Saws and Tools

Easily Made Star Map

(Continued from page 92)

lower at S and correspondingly higher at N, in order to take in Algol and its mate.

To adjust the indicator, pick out the time of day on the shield and the time of the year on the cylinder and bring them into coincidence. The stars that are below the horizon are now hidden by the shield; the rest are shown as they appear overhead. Hold the cylinder so that the horizon line at the top of the shield is level, see that the two equator lines fit, and make sure that the north, east, south, and west points are turned to the proper quarters of the heavens.

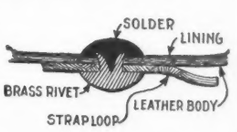
The curved line marked "Ecliptic," through Regulus and Spica, is the line on which the sun and planets move. The map shows all the first-magnitude stars and most of the familiar constellations. The Big Dipper and Orion are the first that a beginner should try to learn. Sirius is the brightest of the fixed stars; it is called the Dog Star, and dog days are the days when it rises and sets with the sun. At the birth of Christ it was a red star, but is now bluish. Aldebaran, Antares, Arcturus and Bellatrix are red stars, Capella is yellow and Vega blue. The nearest of the fixed stars is Alpha of the pair marked Centaur. Its light requires 3½ years to reach us, although light travels at the rate of 186,000 miles a second.

Pole Star is the Pivot

The Pole star is nearly at the point about which the sky apparently revolves, and so it does not seem to move as do the other stars. Vega was once the Pole star, and will be again after 12,000 years. Algol means the "Demon Star"; it has an invisible companion of great size, which every three days partially eclipses its light for about 20 minutes.

The easiest double star to see is one in the handle of the Dipper. The big one of the pair is called Mizar; the little one is Alcor—that is, the horse and the rider. Good eyes can see that the star next to Aldebaran in the Bull is double; but only the best eyes can tell without the help of an opera glass which one of Vega's companions is double. Try it. These last three double stars are not pairs revolving about each other. They are only optical doubles; that is, the two stars are not really near together but only happen to be seen nearly in line from us. Altair is the standard first-magnitude star, and the Pole star is the standard of second magnitude.

Solder Repairs Suit Case



SOLDER and Babbitt metal can be used in many ways for making emergency repairs, one of them being to hold split rivets in place.

A split rivet in my suitcase was torn out and, lacking other means to repair it, I laid some ordinary wire solder on top of the prongs and melted it into a button. After the solder had cooled, I hammered it to clinch the leather tightly and the rivet is holding the strap more securely than when it was new.—N. G. NEAR, Newark, N. J.

"Good for years to come,"

Says
Arthur F. Engel
of his
Millers Falls Bench Drill
bought in 1903

Writes Mr. Engel:

"In 1903 I bought one of your adjustable bench drills, primarily for doing model work connected with my patent and mechanical engineering practice.

"I have made many different machines with it, including a line of automatic eyeletting machines, and I rebuilt an automobile with it several years since, some of the work on which required clamping the drill to the frame of the car, in almost inaccessible places.

"Some months ago I used it in drilling a ¾" hole in a piece of steel rail, for which kind of work, of course, it was not made; and in this particular instance, I had to cut down the shank of the drill, to fit the chuck. I drilled a hole, but I found the undue strain had sprung the chuck shaft and main gear bearing.

"I suppose I ought to retire this drill, on account of old age, but its condition generally is so good, that I will be able to get along with it for years to come if you can renew the chuck shaft, and holder, and the block holding the main gear."

* * *

The reason why Millers Falls Tools last so long in service, is because they are made by men who keenly respect good tools and good workmanship.

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The most complete hand power Bench Drill made. Two rates of automatic feed. Also fed by hand if desired, by means of feed wheel at top.

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Set the spring to suit the job; save drill points

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Driving a 5/32 drill into tough timber takes steam. Turn cap on handle to right, and "Yankee" No. 44 delivers the high-power tension needed.

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Automatic Push Drill No. 44 with Adjustable Tension

The only push drill that can be adjusted to suit each job. E ght drill points, 1/16 to 11/64, in magazine handle.

No. 41 "Yankee" Automatic Push Drill, without adjustable tension.

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Plain Screw-drivers, 1½ to 30-inch blades

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Write for it today and learn about all the ingenious "Yankee" Tools that will save your time and your muscles. Every tool illustrated and exp'ained.

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"YANKEE" TOOLS

Make Better Mechanics

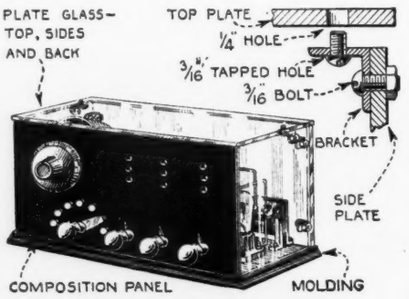
THE HOME WORKSHOP

Glass Cabinet Displays Radio Set

By Joe V. Romig

MOST radio amateurs who have assembled or built a fine looking radio set are reluctant to place it in a cabinet where the larger part of the apparatus is out of sight. A novel and not difficult way to get around this is to build a plate glass cabinet, as shown, using a black composition panel for the front. This construction has advantages over the more common method of making a panel of plate glass because not so many holes have to be drilled into the glass.

The top, ends, and back of the cabinet shown were cut from broken and discarded automobile windshields. Usually pieces of plate glass large enough for this purpose can be obtained in a junk yard or auto repair shop.



The top of this glass cabinet lifts off for making adjustments and repairs

The pieces are cut to size with a good glass cutter and the holes are drilled with a three-cornered file held in a brace or breast drill, turpentine being used as a cutting fluid. A good way to start to drill is to clamp a piece of steel over the spot to be drilled with a hole just large enough to center the file.

Small brackets can be obtained at a hardware store for clamping the plates together. Use small round head screws and flat nuts. To allow adjustments and replacements, the top is merely laid in place. It is prevented from slipping by 3-16-in. screws which are screwed into the top holes in the brackets and serve as pins to engage holes in the glass. A black molding around the base adds to the rich appearance of the cabinet.

BESIDES the method of drilling glass mentioned by Mr. Romig, there are several others that the home worker may find useful in repairing or constructing articles in which glass is used.

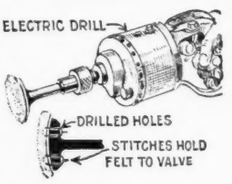
An ordinary steel drill can be used for small holes if it is tempered very hard. If possible, the drill should be tempered in a bath of salt water that has been well boiled and it will then go through the glass rapidly. Because extreme hardness is required, the sharp, freshly broken point of a file often serves well as a drill. Instead of turpentine alone, turpentine in which some camphor has been dissolved is sometimes used as a cutting fluid. Diluted sulphuric acid is also said to be excellent for the same purpose.

A thin brass or copper tube will also cut glass, if emery powder and turpentine are used as an abrasive. Large holes are frequently cut with a tube in this way. One instance of this is in drilling holes in glass windshields for the installation of swivelling auto spotlights. A brass tube notched on the cutting edge is used in conjunction with a paste of No. 60 carborundum compound and water. A portable electric drill provides power sufficient to drill a hole in three minutes.

An even pressure should be preserved in drilling and reduced toward the end.

Electric Drill Operates Buffer

A SERVICEABLE buffer and polisher can quickly be made by drilling holes in an automobile engine valve, as shown, and stitching a piece of heavy felt to it. The valve is held in the chuck of a portable electric drill or any other type of drill available and, while rotating rapidly, pressed against the surface to be rubbed.



One-Control Vacation Radio Set

(*Continued from page 73*)

ferred with inserting the tube. This may be avoided by putting the rheostat directly below the variable condenser, as shown in the mechanical drawings. It is then possible to insert a bezel or window for watching the light of the tube.

Here is a complete list of parts required:

1 23-plate condenser, Vernier preferred.
1 vacuum tube, detector, either dry-cell or storage battery.
1 Socket for tube.
1 rheostat to suit tube.
1 grid leak (variable preferred) and condenser.
1 .002 mfd. fixed condenser.
1 cardboard tube, 3½ in. in diameter.
½ lb. No. 20 single cotton covered wire.
2 lengths spaghetti tubing.
7 binding posts.
Composition panel, 7 in. by 10 in.
A and B batteries.

The ½ lb. of wire will be sufficient for winding the inductance coil and wiring the set. All the connections should be soldered.

It might be added that the set is good even for receiving under unfavorable conditions. By experimenting a little with the number of turns in the primary and secondary coils, it is possible to adjust the set in combination with any relatively short aerial so that it will receive signals only between certain wave-lengths, as from 300 to 500 meters, so that interference from code stations, either amateur or commercial, can be made practically impossible.

The aerial should always be fairly short with a set such as this, not more than 50 or 70 ft. at most. With an aerial 45 ft. long and 30 ft. high, WDAP in Chicago, WLW in Cincinnati and many others have been heard in New York.

Repairing Old Wall Clocks

IN REPAIRING old clocks I have often found that the screws fastening the works to the back of the case have loosened and let one side of the movement hang down out of plumb. The clock would not therefore, keep correct time even if the case and shelf were perfectly level. This can be repaired by plugging the old screw holes with soft wood or by moving the works over to one side ¼ in. and making new holes for the screws.—C. O. Soots, North Salem, Ind.

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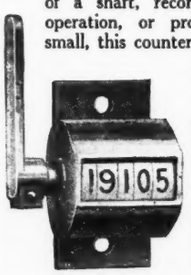
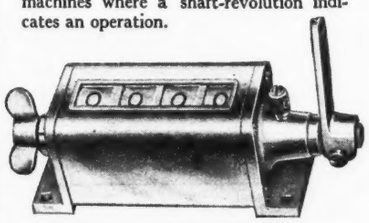
Veeder COUNTERS

The small Revolution Counter below registers one for a revolution of a shaft, recording a machine operation, or product. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially suitable for light, fast-running machines, and most adaptable to experimental work. If run backward the counter subtracts. Price $2.00. (*Cut 4/5 size.*) Small Rotary Ratchet Counter, to register reciprocating movements of small machines, also $2.00.



The Revolution Set-Back Counter below records the output of the larger machines where a shaft-revolution indicates an operation.



Sets back to zero from any figure by turning knob once around. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels as illustrated, $10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, $11.50 (list).

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Bryan on Evolution

(*Continued from page 23*)

science with which man is best acquainted and from which he has drawn the largest practical benefit, presents what seems to be conclusive evidence against evolution. Chemistry deals with the original elements some ninety-two of which have been found on the Earth. Its business is to separate these elements one from the other, to analyze them, and to reveal their differences and relationships. If the evolutionary hypothesis is true *anywhere*, it must be true *everywhere*. It cannot be isolated like a germ and confined to some particular portion of the universe. If it explains the heavenly bodies, the strata of rock, vegetable life, animal life, and man, linking each to every other by indissoluble ties, then surely it must exert a controlling influence over every atom of matter (and over the 1740 electrons which make up the atom) and over every larger unit of matter, wherever it is found and whatever it is doing.

Chemistry has not discovered any law of evolution. It has registered the various gases and diagrammed the movements of the molecules, but it has discovered no pushing force at work in the original elements of which all things animate and inanimate are composed. Chemistry is an exact science; it mocks the atheist and brings confusion to the evolutionist.

Water Cited as Example

Let us take, for instance, the best known thing with which man deals—water. It is the daily need of every living thing. Without it, there could be neither plant nor animal life. It was, therefore, on the Earth before either plant or animal life appeared. It is the largest single element in man's body.

Water is composed of hydrogen and oxygen, H_2O. Is it conceivable that two such gases as oxygen and hydrogen should just happen? And yet, according to Professor Leuba of Bryn Mawr University, in his book "Belief in God and Immortality," more than half the prominent scientists of the United States do not believe in a personal God.

But even if it were conceivable that chance could bring into existence oxygen and hydrogen, could chance unite them at a certain fixed ratio, so that a drop of water is always and ever the same wherever found, whether in the clouds, in the ocean, or in the veins of the Earth? Oxygen and hydrogen are inflammable when separated, but when they are united in water they put out fire. If the evolutionary hypothesis which assumes constant progress in everything, is true, water must have developed from something. What was water before it became water, and what will it be when it ceases to be water? Or was the law of change suspended when the two gases united in the formation of water?

Everything that man eats, wears or uses will serve as an illustration of exact and *permanent* relationship between various forms of matter.

Chemistry has taught us the properties of matter and the way to utilize them, but they are now stationary. We can collect nitrogen from the air but, as Dr. Edward Slossen says, "We are dreadfully clumsy about it." He adds that man "takes a thousand-horsepower engine and electric furnaces at several thousand degrees to get carbon into combination with hydrogen,

(*Turn to page 96*)

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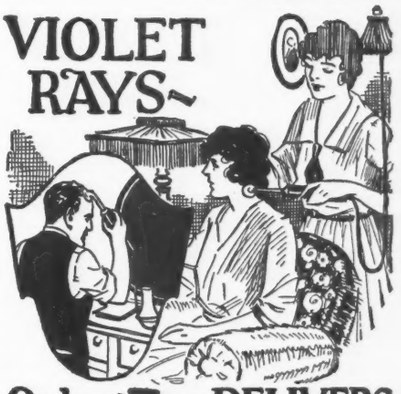

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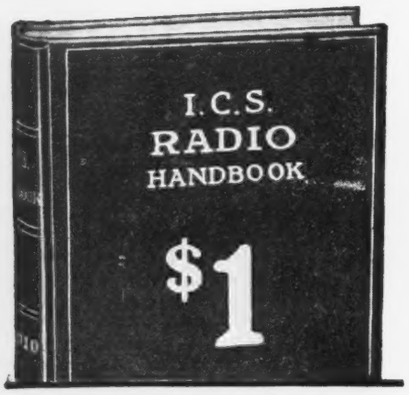

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Bryan on Evolution

(*Continued from page 95*)

while the little green leaf in summer time does it quietly without getting hot about it." And yet some scientists who know all about hydrogen, oxygen and carbon seem to know nothing about God; they even deny His existence.

The natural and logical tendency of evolution is to produce agnosticism, and agnosticism is merely a way station on the road to atheism. It furnishes an excuse for the indolent man; it is the laziest excuse ever invented to justify inaction.

If a man believes in evolution, he can go to the zoological garden on Sunday morning and standing in front of a cage of animals, speculate on how far he has come, on his superiority over his ancestors. There are some people who would rather boast of what their forefathers have done than do anything themselves.

If, however, one is a Christian, he feels that he should attend church and seek to know how far he has yet to go before he is "perfect, even as your Father which is in Heaven is perfect."

The evolutionary hypothesis robs man's conscience of its compelling force. What feeling of duty can man have or what sense of responsibility to God if it must be strained through the blood of all the animal life below man? Religion, on the contrary, inspires to action. Christianity is not a lazy man's job. It presents the highest ideal known.

Charges Against Evolution

Evolution is the doctrine of the fatalist—the plea of the invertebrate. If a man is but a "bundle of tendencies inherited from the brute," why hold him accountable if, following the instincts of his remote ancestry, he is brutish? Evolution excuses the sensualist and encourages the worshipper of the god of ease.

The great need of the world today is to get back to God—to a real belief in a living God. Evolutionists either deny the existence of a God or put Him so far away that consciousness of His presence in the life is weakened, if not destroyed. When they have eliminated all of the Bible that conflicts with evolution, the Bible is no longer an authority, but merely a "scrap of paper."

The world needs the Christ of whom the Bible tells. Evolutionists rob the Saviour of the glory of a virgin birth, of the majesty of His deity, and of the triumph of His resurrection. Such a Christ is impotent to save. The world needs a full-statured Christ; not a man aspiring to be a God, but a God condescending to be a man. His blood has colored the stream of time; His philosophy fits into every human need; His teachings furnish the only solution of the problems that vex our hearts and perplex the world.

We do not ask that teachers paid by taxation shall teach the Christian religion to students, but we do insist that they shall not teach, under the guise of either science or philosophy, anything that undermines faith in God, impairs belief in the Bible, or discredits Christ, the Son of God and Savior of the World.

Editor's Note—The material in this article was contained in an address recently delivered by Mr. Bryan before the State Legislature at Charleston, West Virginia, and is not copyrighted by Popular Science Monthly.

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How Much Do You Know about Science?

FOLLOWING are the correct answers to the 30 questions on fundamental facts of science printed on page 48 of this issue. Grade yourself 10 points for each question answered correctly and see how near you come to a 100 per cent score for each classification.

Electricity and Radio

1. Anything which will detach electrons from their position inside of atoms and makes them move by themselves gives us electricity. For instance, a battery detaches electrons by means of a chemical reaction and piles them up on one plate of the battery so that they can be forced to stream off through a wire and back to the other plate.
2. In direct current the stream of electrons moves continually in one direction through the wire. In alternating current it moves first in one direction then in the other.
3. When the electrons jump across as a lightning flash they heat the air. This hot air expands suddenly, then suddenly contracts again. This makes a noise in the same way that an explosion does.
4. This is what used to be called static electricity. What happens is that by stroking a lot of electrons get detached from the atoms to which they belong and accumulate here and there in groups. Sometimes there are so many of them that they jump between the cat's fur and your hand and make little sparks.
5. Fuses are put in systems of electric wiring to prevent too much current passing through the wire. Otherwise the wire might get hot and set fire to the house. The fuse is made of a kind of soft wire which is easily melted. If you put too much load on the circuit so that a dangerous amount of current passes, or if some accidental short circuit happens, the fuse gets hot and melts. This stops the current so that no further damage is done.
6. A few atoms of tungsten are always evaporating from the hot filament just as water evaporates from a pan of hot water. In time this gradual loss of tungsten makes the filament thinner. Finally it becomes so thin that it breaks.
7. There are waves in the ether, just like light waves except that they are much longer. The waves of light are all less than a millionth of a meter long; while the radio waves are mostly between 100 meters and 10,000 meters each. One hundred meters is 328 feet.
8. No. The wireless waves go out in all directions from the sending station, just like the water waves on the surface of a pond. They come from another station in just the same way.
9. The radio waves used in broadcasting are always of a definite wave length. Most of the stations use waves 365 meters long. Tuning consists in adjusting your set until it responds exactly to this wave length. In the same way if two violin strings are tuned exactly alike and one of them is set vibrating by playing it the other string will vibrate also.
10. No more danger than there is of its striking a chimney or a tin roof.

What Is Life?

1. Yes. It was believed once that the living creatures which appear, apparently spontaneously, in open dishes of food materials actually were generated there. But Pasteur, the celebrated French scientist, showed that these really are produced from germs from the air.
2. Every attempt to create living matter artificially has failed. Experimenters, however, have been able to duplicate many of the properties of living matter.
3. Protoplasm, which is the essential property of creation and the fundamental

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thing in living matter is more than half water. If any large fraction of this water is removed from protoplasm the protoplasm dies.

4. Scientists think not. The monkey and the man had a common ancestor, but that is all.

5. Because it is able to give its body a twist just as it begins to fall. Probably this power was acquired by the cat family during many ages of living in trees.

6. We may be sure that many of them can, especially the higher insects like the ants and the bees.

7. Their stinging apparatus is much like the hypodermic needle that doctors use. The bee jabs his little needle into your flesh and through the hollow center of it he forces a tiny drop of poison.

8. The moths do not like the smell of naphthalene, which is the chemical from which moth balls are made.

9. To allow the excess of water to run away. The roots of plants have to breathe just as all other living matter does. So they must have a certain amount of air in the soil. If the soil is full of water, the roots suffocate and die.

10. Yeast is composed of many millions of tiny one-celled living plants. When yeast grows the cells multiply by division, each cell dividing into two new cells which go off independently.

The Story of the Mind

1. The outside layer or grey matter, the part that does all the real thinking, consists of nearly ten billion separate nerve cells. Each of these cells has its own tail-like nerve fiber. The great mass of these separate fibers makes up the inside or white part of the brain.

2. Our nervous system is made up of separate living cells. The nerves are outgrowths from these cells, each nerve being a bundle of fibers and each fiber being a sort of long, thin tail that grows out from a living cell.

3. Scientists believe that thought consists of nerve messages passed around among the nerve cells in the grey matter of the brain. Your eye sees the words on this page and a message of them is flashed by your eye nerve to your brain. That starts a lot of other brain cells into operation and they pass messages back and forth.

4. The higher animals can. In certain matters like getting food or escaping from enemies they can think almost as well as we can.

5. A healthy nerve is always ready to carry a message just as soon as it is given one. If the body is in bad condition for some reason, the nerves sometimes get too ready for orders, like a racer making false starts. This makes what we call nervousness.

6. One of the modern theories of psychology is that our minds may contain ideas or mental tendencies of which we are not ordinarily conscious but which nevertheless influence what we do and think. Suppose you are about to drink some soup. Automatically you pick up the proper spoon. Your unconscious mind picks up the spoon for you without your thinking about it at all.

7. It is a method developed in the last few years of finding out what is going on in one's unconscious mind.

8. The movements of the sleep-walker are under the control, temporarily, of his unconscious mind. The conscious part of his mind is asleep and knows nothing about what is going on.

9. A person blushes because all the little blood vessels of the face expand and become gorged with blood, the color of which shows through the skin. The enlargement of the blood vessels is due to a nerve order from the brain.

10. Yes, probably more than they learn during any later years. They not only learn how to move their muscles and how to use their eyes and other senses and how to make their bodies do what they want them to, but they also learn many mental habits.

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How to Take a Bath

(*Continued from page 45*)

bad case of "shingles," the popular name for a common skin irritation. On questioning him, I found that he was in the habit of taking three cold baths a day, believing they would "toughen" him. All he needed to restore his skin to normal condition was abandonment of these literally shocking baths.

Here are a few of the most important scientific rules for bathing which, if followed, will be found beneficial:

1—Take a short bath.

2—Spend as much time drying the skin as you spent in wetting it.

3—Bathe in water at body temperature, or as near body temperature as possible.

4—Do not bathe while perspiring freely.

5—Do not wet the hair every time you bathe.

Scientifically, there is even a right and a wrong way to get into a bath. Whether it is a shower or tub bath, the hands should be placed in the water first. Next, moisten the arms and shoulders, then the body. Wet the feet and legs last, and finally immerse the body, rubbing it lightly with the hands. Move the body constantly while you are in the bath.

In addition, care should be used both in the selection and application of soap, which if it is of poor grade or is used too frequently, will roughen the skin and cause irritation.

The rule concerning avoidance of shock in bathing should be followed closely by persons suffering from weak hearts or thickened blood. Fat persons upset their circulation and incidentally their dispositions by taking cold baths in summer. Thin persons cannot afford to lose the heat extracted by a cold bath, and if they follow the practice they will lose weight. If relief from heat is sought a short Turkish bath is better than a plunge into icy water.

Beach Bathing

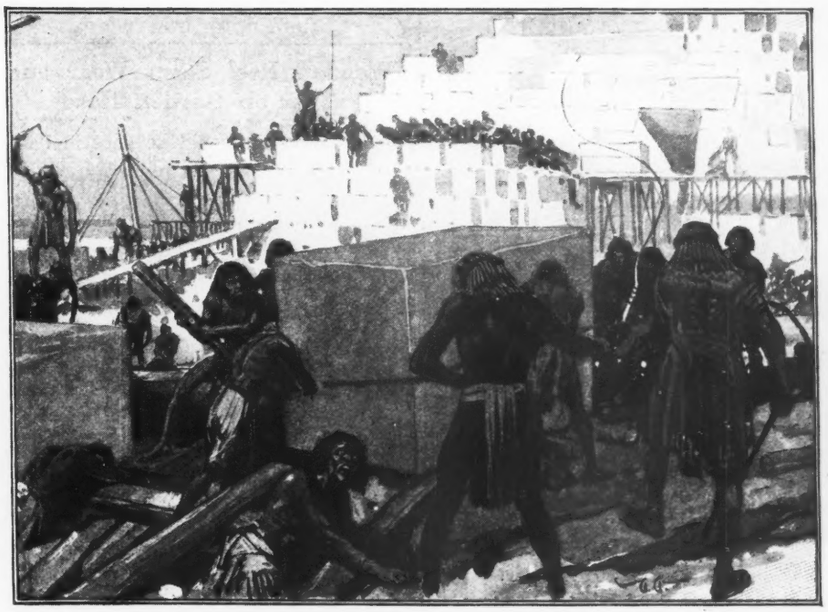
There are many common-sense rules for summer-resort bathing which, if followed, would add much to the benefits of a vacation.

At the beach, exercise moderately before going in, and continue to exercise by swimming or splashing while you are in the water. When you come out, exercise in the air for a few minutes before dressing, and do not lie in a wet bathing suit to bake in the sun.

Don't always blame the water for faults that may be your own. Many cases of ptomaine poisoning and cramps, for instance, have been attributed to poisonous materials in swimming water, when as a matter of fact the disturbance is caused by over-sensitive skin nerves. "Goose-flesh" and cold perspiration after sudden fright, are common evidences of the close association of the sensitive skin and the nervous system.

Nerves and digestion are not the only things that are impaired by improper bathing. Sleep also falls victim to unscientific baths. One sleeps soundly when there is a warm glow of perspiration. When the skin is dry, sleep is disturbed because this dryness upsets the even balance between bodily heat and the evaporation of perspiration at the surface. When the skin is thus inactive the kidneys and lungs must bear a greater burden.

Bathe intelligently, then, rather than often, for health.



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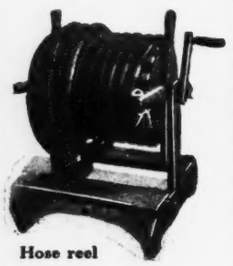
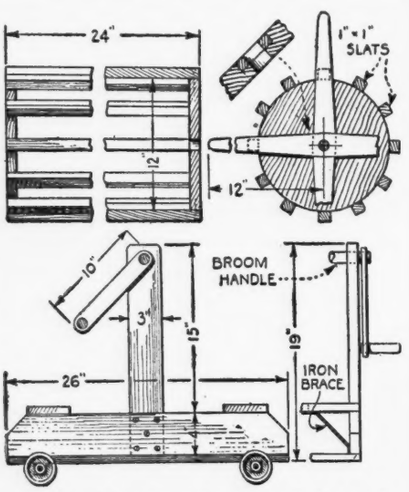
Wooden Reel Saves Wear and Tear on Garden Hose

MANY lawns would be kept in better condition during the hot summer months if the garden hose could be moved from the back yard to the front of the house on a reel instead of by the primitive but common method of carrying it in a wet, muddy coil over the shoulder. To make a suitable reel requires only a small amount of 1-in. wood and a little spare time. Two disks 12 in. in diameter are cut out to form the ends of the reel and bored to receive the broomstick shaft. The drum is then made by nailing on 1 by 1-in. strips as shown in detail below.



Hose reel

The hose guides are 2½ in. wide at the center and taper to 1¼ in. at their outer ends. The uprights that form the bearings for the wooden shaft are securely held to the base with five screws each and the whole is further braced by five iron braces,



Details of the hose reel and stand, designed to carry about 60 ft. of ¾-in. rubber hose

placed as indicated. A crankshaft is mortised on to the shaft.

The whole may be mounted on a platform with small iron wheels, if desired. The reel will carry about 60 ft. of ¾-in. rubber hose. If a greater length is to be used, make the drum 36 in. long and 15 in. in diameter, so that the center of gravity will remain low and there will be no danger of tipping over.—E. E. SCOTT, Pittsfield, Mass.

Building a Radio Set

IN CONSTRUCTING a radio set it is not necessary to follow directions to the letter. The tuning coils can be wound on tubes of various sizes from 3 to 5 in. with wire of any size from No. 26 to No. 20 covered by any suitable type of insulation. Primary coils should have at least 30 turns; secondary coils 40 to 60, and tickler coils 50 to 75 turns.

All leads should be as short as possible. In no instance should the plate leads run parallel to the grid leads. It is advisable to place the filament leads toward the front of the set and the plate and grid leads as far away as possible.—J. C.

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Power Plant Drives Lawnmower

(*Continued from page 76*)

it is through this mechanism that the mower is elevated. The elevating lever and pull rod are mounted on the left handle, as shown.

The motor is mounted so that the driving pulley extends outside the frame, and the jack shaft pulley is similarly mounted. These small 1½ hp. motors run at their most efficient speed at about 600 RPM, and the sizes of all wheels and pulleys are designed for a speed of about 2½ miles an hour.

The jack shaft is laid in two brass bearings, bolted to the round section of the frame, as shown, and kept in place by the hub of the pulley and the pinned collar on the shaft. In the center of this shaft is fastened the 5-in. sprocket wheel for the drive chain.

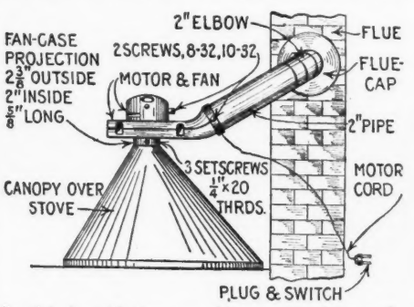
In order to eliminate a bulky and cumbersome clutch, a belt tightener is used to tighten the motor belt and it also acts as a friction clutch. The idler pulley is mounted on a swinging bracket and is pulled in place by the right-hand lever.

Both operating levers are mounted on a ⅝-in. threaded bar, which also braces the top of the handles. Each lever has a bent latch arrangement that holds the lever up and in place when it is elevated. This is accomplished by the pivot point's going just a little beyond or over the center. The hit-and-miss type of engine needs no spark or throttle control.

Exhaust Fan Carries off Heat of Summer Cooking

STOVES and ranges equipped with hoods or canopies can be fitted quite easily with an electric fan to exhaust the heated air. The details can be arranged to suit the various types of hoods in use.

In the installation shown the top ring for the fan connection is 2½ in. in outside



In this installation an old vacumn cleaner fan draws the hot air from beneath the canopy

diameter, ⅛ in. thick, and ⅝ in. wide. The lower half of the fan case of a vacuum cleaner fan was attached to this ring with three ¼-in. screws. A 2-in. stovepipe connects the outside of the discharge end of the fan case to the chimney. Arrange a motor cord and plug to make connection to a convenient outlet.—WILLIAM F. WEBER, Indianapolis, Ind.

Varnishing Cannot be Hurried

TO HURRY the process of varnishing invites failure. If a second coat is applied before the first one is thoroughly hard, the varnish is apt to crack. If driers are added to the varnish to hurry its drying qualities, it is likely to cause pinholes and other defects.—S. M. E.

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St. Louis smoker moves into second place

With 405 cans to his credit Mr. Thurston smokes his way towards the lead

Mr. Byron Thurston of St. Louis is more than qualified for membership in the Edgeworth Club. But his position in the championship-smoker class is not so well established. Mr. Thurston's interesting letter follows:

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Gentlemen:

I have often heard of great smokers of one kind of tobacco.

I have smoked 405 cans of Edgeworth Plug Slice 35c size without changing.

Now if you know of any better record I would be glad to hear from you. I smoke one can of tobacco in two days and enjoy every pipeful.

Yours truly,
(Signed) Byron Thurston.

More than a year ago an Edgeworth smoker from Burlington, Vermont, Mr. H. F. Baldwin, wrote in suggesting that he had smoked more Edgeworth than any other living man. At that time he had smoked over 1000 cans of the same size purchased by Mr. Thurston, distributed over a period of nearly a score of years.

So while it appears today that Mr. Thurston is well behind the leader, if he continues smoking a can every two days, it may be only a matter of years before he will be well in advance of the entire field.

Edgeworth has something about it that holds smokers.

If you have never tried Edgeworth, Larus & Brother Company will be glad to send you free samples of both Edgeworth Plug Slice and Ready Rubbed.

Just drop a postcard to Larus & Brother Company, 59 South 21st Street, Richmond, Va., and the free samples will be forwarded to you promptly.

If you will also include the name and address of your regular tobacco dealer, your courtesy will be appreciated.

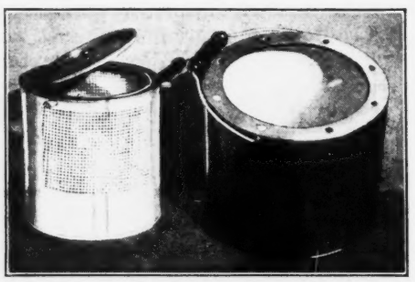
Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Ready-Rubbed come in small, pocket-size packages, in attractive tin humidors and in handy in-between sizes.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

THE HOME WORKSHOP

Novel Bait Pail Keeps Minnows Alive in Hot Weather

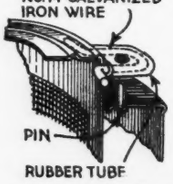
I USE the homemade minnow bucket illustrated on the hottest days of the season without losing more than two or three out of the hundred or more minnows the pail holds. It is made from a peanut



Sufficient water to cover the minnows is always retained at the bottom of the inner pail

can and a pail and costs less than 50 cents.

The construction is made clear in the illustrations. The three extension lips at the top edge of the inner pail are covered with soft rubber tubing. I have now added three heavy escutcheon pins to the outer bucket so that they engage the lips and prevent the pail from shifting. The outfit is enameled blue on the outside and white on the inside and then baked. After two years' hard use, it is still in excellent condition.—F. F. Howe, Milwaukee, Wis.



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Hose Holder Saves Time

A ⅛-IN. brass rod 14 in. long sharpened at one end, and fitted with a clip made of 18 or 20-gage brass at the other, is an excellent holder for the garden hose.

How holder is made and used

The pointed end is pressed into the ground and the nozzle slipped into the clip.

This holder holds the nozzle in any desired position, and when one part of the lawn has been sprinkled the whole contrivance, nozzle and all, is turned as on a pivot so as to water another section. It takes only a few minutes to shape the rod and clip and solder the two together.—J. M. W.

Using Radio Power Tubes

IN ORDER to obtain very loud results from a radio loud speaker, a power tube can be used in the last audio frequency stage set and 150 to 300 volts applied to the plate circuit of that tube. More than 100 volts should not be used in any plate circuit, however, where an ordinary transformer and phones are used.—F. C. A.

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31x4	9.90	1.40	34x4½	14.90	2.15
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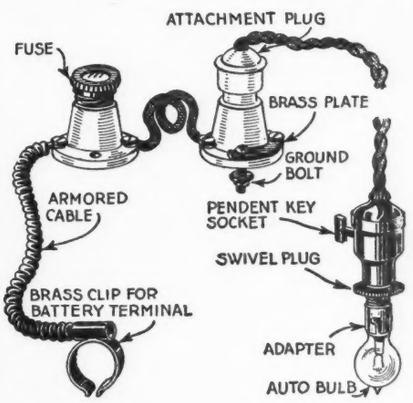
Auto Provides Light for Summer Cottage or Camp

By H. H. Parker

BY INSTALLING an extra lead from the starting battery, an automobile can be used quite satisfactorily for lighting a small country shack or cottage or a camp while on a summer trip. Care must be taken, of course, that the battery is not exhausted through over use, but if the machine is being used normally every day the battery will be sufficiently charged to take care of the extra demands upon it.

One 21-candle headlight bulb with a reflector gives ample light for reading. This article is, indeed, being written with the aid of such a lamp and a combination house and garage has been lighted in this way without ever exhausting the battery or requiring outside charge to be given it. For ordinary use lamps of less candlepower will suffice.

Room always can be found somewhere under the dash of the car to screw a stock



Standard fixtures are used in arranging an auto lighting system for summer use

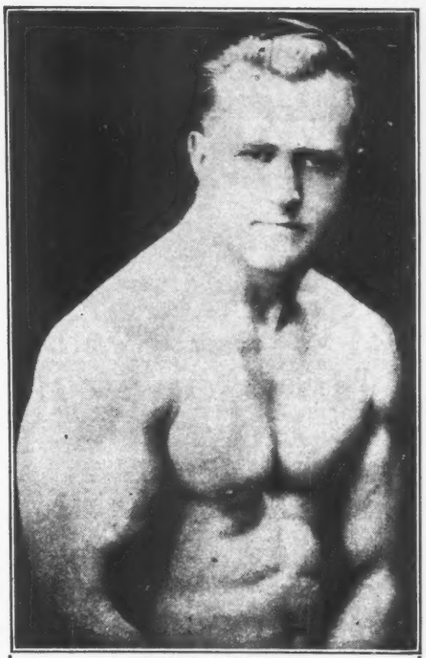
type 110-volt porcelain wall socket. Stock fixtures such as this are easily adapted to the low voltage circuit and are much more substantial than the small auto lighting fittings.

This socket connects with a battery terminal but a fuse should be installed between to guard against accidental outside short circuits. Another porcelain socket 10-ampere fuse plug can be used for this; it can be screwed under the machine or bolted to the frame, or under the dash. In the latter case it is best to combine the two sockets by using a porcelain base double fuse block. See that the two sockets are connected in series instead of parallel, as when two fuses are used. Most machines have the single wire ground system, so one fuse is sufficient.

A heavy and well insulated battery lead, preferably of single conductor armored cable, should be used. Some sort of clamp can be made of heavy sheet brass to fit over the battery terminal; the shape will depend upon the make of battery. If well tinned with solder, corrosion from the battery acid will be largely prevented. One terminal of the dash socket is grounded by means of a curved brass plate extending from the terminal screw to a bolt holding the socket to the dash.

Attach leads from the attachment plug and connect up the lights. As the voltage is only 6 or 12 volts, fairly large leads must be used if they are run any distance, other-

(*Turn to page 104*)



EARLE E. LIEDERMAN
as he is today

Gee! But It's Great To Be Healthy!

Up in the morning brimming with pep. Eat like a kid and off for the day's work feeling like a race horse. You don't care how much work awaits you, for that's what you crave—hard work and plenty of it. And when the day is over, are you tired? I should say not. Those days are gone forever. That's the way a strong healthy man acts. His broad chest breathes deep with oxygen purifying his blood so that his very body tingles with life. His brain is clear and his eyes sparkle. He has a spring to his step and a confidence to tackle anything at any time.

Pity the Weakling

Don't you feel sorry for those poor fellows dragging along through life with a neglected body? They are up and around a full half hour in the morning before they are half awake. They taste a bite of food and call it a breakfast. Shuffle off to work and drag through the day. It's no wonder so few of them ever succeed. Nobody wants a dead one hanging around. It's the live ones that count.

Strength Is Yours

Wake up fellows and look the facts in the face. It's up to you right now. What do you plan to be—a live one or a dead one? Health and strength are yours if you'll work for them, so why choose a life of suffering and failure?

Exercise will do it. By that I mean the right kind of exercise. Yes, your body needs it just as much as it does food. If you don't get it you soon develop into a flat-chested, narrow-shouldered weakling with a brain that needs all kinds of stimulants and foolish treatments to make it act. I know what I am talking about. I haven't devoted all these years for nothing. Come to me and give me the facts and I'll transform that body of yours so you won't know it. I will broaden your shoulders, fill out your chest, and give you the arms and legs of a real man. Meanwhile, I work on the muscles in and around your vital organs, making your heart pump rich, pure blood and putting real pep in your old backbone. This is no idle talk. I don't promise these things—I guarantee them. If you doubt me, come on and make me prove it. That's what I like.

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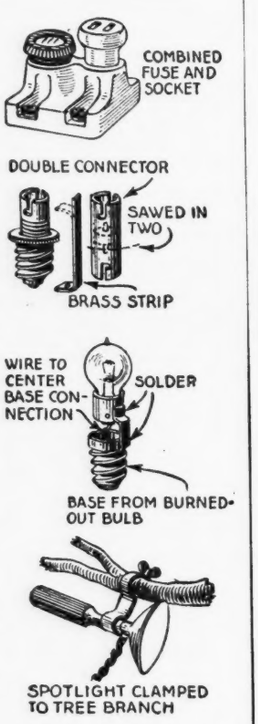
THE HOME WORKSHOP

Auto Provides Light

(*Continued from page 103*)

wise there will be too great a voltage drop. All lights must, of course, be connected in parallel and no more should be burned at one time than needed.

Bayonet base auto lighting bulbs are easily adapted to stock pattern screw sockets by means of a swivel attachment plug, which can be bought for about 17 cents, and a double bayonet base connector. Saw the connector tube in two just below the fiber plug holding the center plunger; unscrew the fiber cap of the attachment plug and discard it; then fasten the inner sleeve and the swivel cap with a drop of solder so that the cap cannot turn. Cut a narrow strip of spring brass to fit up into the center terminal hole of the plug, clamp the outer end under the lower terminal screw and bend down the inside end so that it can make contact with the connector plunger when this is soldered into the sleeve. It will be found that the connector tube, if filed slightly, will make a close fit into the attachment plug screw sleeve, to which it is to be soldered. Then screw the plug into a standard socket and the low voltage bulb can be pushed in.



Auto light adapters and other details

Another method is to use the brass base of a burned-out 110-volt globe. Solder a brass strip to the outside of the base and solder the bayonet base of the auto bulb to the other end, bending the strip so that the bulb will be centrally placed over the base. Then solder the small wire coming up from the center base terminal to the center terminal of the bulb. The disadvantage of this is that if the lamp should burn out, another cannot be placed immediately, unless all lamps on hand have been so converted and supplied with screw bases.

A pendant key socket with swivel plug adaptor makes a good combination, as the light can be switched on or off at pleasure. A spotlight on the end of a long lead is useful about camp as it can be clamped to a tree or other support and will throw a brilliant light in any direction.

Many unusually helpful woodworking articles will appear in forthcoming issues of POPULAR SCIENCE MONTHLY. One will tell how to make inexpensive but fine looking picture frames; another will give a unique method of making neat tables with plain nailed and screwed joints for the home; a third will provide complete details for a mission table and desk.

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This book contains complete instructions for building small alternating current motors in several sizes. The designs will be found in harmony with those of the very best manufacturers and they can be worked out by the amateur for making useful instruments. Clear, concise directions and careful drawings are features of this book.

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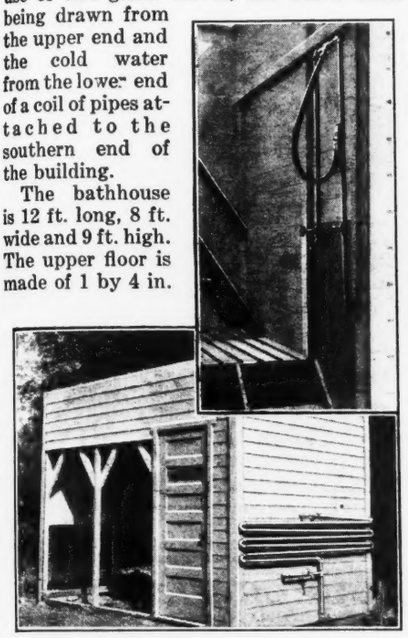
POPULAR SCIENCE MONTHLY
225 West 39th Street, New York City

THE HOME WORKSHOP

Solar Bathhouse Provides for Sun and Shower Baths

THE combined sun and shower bathhouse illustrated, is one I built in a location where the sun's heat could be depended upon most of the year. This heat is utilized for taking the chill off the otherwise ice-cold water sufficiently to make bathing a pleasure. The water is, in fact, usually too warm unless mixed with cold water. The mixture is regulated, as shown in the upper photograph, by the use of two globe valves, the warm water being drawn from the upper end and the cold water from the lower end of a coil of pipes attached to the southern end of the building.

The bathhouse is 12 ft. long, 8 ft. wide and 9 ft. high. The upper floor is made of 1 by 4 in.



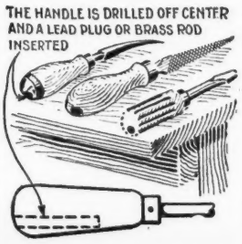
Water lying in the coil of pipes is warmed by the sun sufficiently to make shower-bathing enjoyable

dressed boards, the edges of which were painted before the boards were nailed. The parapet around the floor is about 3 ft. high and, of course, the top is open, so that one can expose the entire body to the beneficial rays of the sun. Steps lead from the shower bathroom on the first floor to the roof.

The sun water heater in this case consists of five 8-ft. lengths and two 4-ft. lengths of 1-in. galvanized pipe connected as shown, and ½-in. pipes carry the water indoors to a short length of rubber hose and a bath spray. Where the sun is not so hot, more or larger pipes can be used and provision must be made for draining the pipes at the end of the season.—E. W. WILLAT, Culver City, Calif.

To Prevent Tools from Rolling

SCREWDRIVERS, files, scrapers, and other tools that have a constant tendency to roll off the bench or machine can be improved by the simple expedient of weighting one side of the handle. A hole is drilled off center into the handle, as shown, and plugged with a piece of lead, or brass or other rod.—L. S. C.



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Small Ornamental Fountain Made of Cement or Plaster

A SMALL fountain for the conservatory, sun porch, or sheltered nook in the garden can be made without much difficulty from either waterproofed plaster of Paris or cement. If piped water from the house main cannot conveniently be obtained, a tank can be installed in the pedestal and compressed air pumped into it to operate the fountain spray when desired.

To make the basin, first form a core from strong wire netting of about ½-in. mesh. Bend a ¼-in. square or round bar of iron into a ring the size of the outside rim and wire the netting to it, bending the mesh over to make a curved edge. Cut a hole 2 or 3 in. in diameter in the center for the pipe and another for the plug.

Support the basin temporarily in a hole in the ground or in some other convenient way and, if you wish a cement fountain, mix one part of cement with two of sand. If it is to look like marble, use good plaster of Paris that you know is fresh and has not been exposed to dampness. The process is the same with either, so I shall describe only the plaster process.

This decorative fountain, made without the use of molds, is operated either by the house water supply or by compressed air

Mix a bucket of the plaster to the consistency of thick cream. Dip a piece of burlap, previously cut to fit the inside of the basin, into the plaster and quickly lay it in position, covering all the netting, including the curved edge. The burlap may be laid on in pieces, if preferred. Pour in the rest of the plaster and smooth it over with your hand and a piece of wood cut to fit the curve of the basin. Repeat until there is a smooth layer about ½ in. thick. Plaster sets very quickly and cannot be worked successfully when once it has begun to set.

Leave the basin at least two days to get hard and then turn it over carefully and give the outside a similar coat, first sprinkling with water the plaster previously laid.

There are several ways of waterproofing the basin. One of the best is to coat it with mica and collodion. Make the mica perfectly white by boiling it in hydrochloric acid. See that it is finely ground and sifted and then mix it with diluted collodion to the consistency of oil paint, and apply it with a soft brush. This will give a fine silvery luster. The plaster must be thoroughly dry before the waterproofing is applied.

If you don't wish to attempt this,

(*Continued on page 107*)

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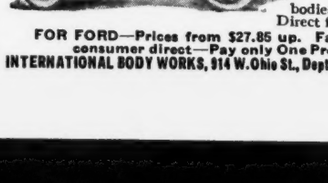

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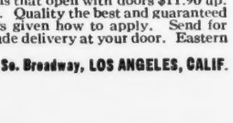

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Small Ornamental Fountain

(*Continued from page 106*)

paint the basin with a hot solution of soft soap. Let it dry thoroughly and then coat it with waterproof varnish or paint.

Build a pedestal for the basin to suit its location and your own taste. You can ornament it with plaster ornaments or wooden carving and moldings. If the basin is plaster of Paris, paint the pedestal white, and if the basin is cement, coat the pedestal with a wash of cement and water.

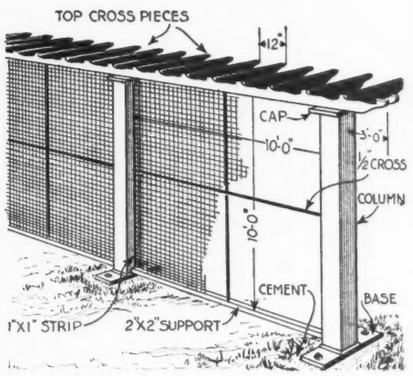
If you have not been able to pipe water to the fountain, provide a space in the pedestal for a square or round tank. Fasten a pipe in the center so that it comes to within an inch of the bottom, as shown, and on top solder a thimble with one small hole, if you wish a single spray, or more for a multiple spray. In one corner solder a short pipe to take a tire valve and also place a tap or plug at the bottom to drain off the water occasionally. It is well to place a strainer over the bottom of the fountain pipe.

Set the tank in the pedestal and place the basin on it so that the pipe is in the center and a plug goes through the other hole. Fill in around the pipes with plaster or cement.

To operate, unscrew the cap *A* and fill the tank one third with water. Close the cap and the valve *B* and pump air into the tank with a tire pump, as at *C*. You must have considerably more air than water space, as air is compressible and water is not. Then turn the tap *B* and the water will come up as a fountain. The height can be regulated so that it will not be too high at first and too low later on. When all the water has left the tank, open cap *A* and repeat the process. The tank and all the joints must be strong and airtight to withstand the pressure and, of course, the pedestal must be strong and rigid to sustain the weight.—A. E. McCann.

How to Build a Pergola Backstop for the Tennis Court

By B. Francis Dashiell
Mechanical Engineer



PERGOLA backstops add much to the attractiveness of the home tennis court and are not a great deal more expensive to build than the more or less plain and crude type often used.

The possibility of planting shrubs and climbing roses beside each column, or at least the outside columns of the backstops, adds further to the general appearance of the grounds.

The length of the backstops will depend

(*Turn to page 108*)

One of the World's Largest Manufacturers with unlimited resources Builds Cunningham Tubes

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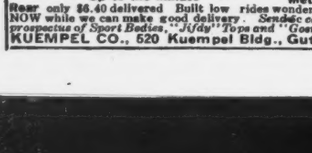

Keen, Classy Up-to-the-Minute

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THE HOME WORKSHOP

Building a Pergola Backstop

(*Continued from page 107*)

upon the grounds and the space devoted to the court or courts. Sufficient space should be left behind the end lines to allow playing margin.

The columns divide each backstop into panels 10 ft. square. A small concrete foundation should be made for each column and two long anchor bolts set in place before the cement hardens. Have the tops flush with the surface of the ground and all on the same level.

Dressed lumber, 1 by 12 in. by 10 ft. is used for building up the box-like columns, each of which is provided with a cap and base of 2-in. material. The cap is 2 ft. long and the base 3 ft. long, both 18 in. wide. They are attached to the columns with nails and screws, and the joints are covered with half-round molding.

Two long parallel beams, 1½ by 12 in., run the entire length of the backstop, across the tops of the columns. They stand on edge, 14 in. apart. Notches 1 in. deep are cut in the lower edges, where they fit over the top caps of the columns. The ends project 3 ft. beyond the end columns and are cut to the same shape as the decorative pergola pieces on top. If there is any other pergola work on the grounds, the same design should be adhered to.

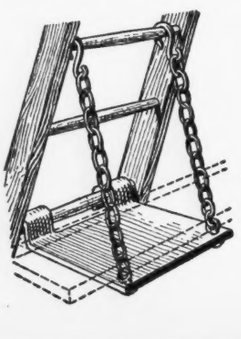
The cross pieces are ⅞ in. by 9 in. by 3 ft. 6 in. and are notched 2 in. deep to fit over the top edges of the long beams. They are spaced 1 ft. apart. A dressed strip 2 by 2 in. by 10 ft. is placed between the columns at the bottom and rests on the edges of the base pieces, and strips 1 in. square by 10 ft. long are nailed to the inside faces of the columns to provide nailing strips for the ends of the netting. Four lengths of ½-in. galvanized iron pipe, each 5 ft. 4 in. long, are joined at the center with a cross fitting and are bolted in place with pipe locknuts to form a large cross support for the netting.

Poultry netting 5 ft. wide is used to fill the spaces between the columns. Where the edges join at the horizontal member of the cross pipe, they are bound to it with soft iron wire. The lower edge of the netting is tacked tightly to the lower cross support, the ends to the 1 by 1 in. strips, and the top is supported by wire fastened to the bottoms of the cross pieces.

Paint the woodwork with two or three coats of white lead and oil paint, and the wire netting and pipes with dark or black outside enamel.

Ladder Bracket for Painting

IN PAINTING the side of a house or other building it is not always convenient to erect a scaffold, especially if the work is to be done by one man. In such cases, a plank supported between two ladder brackets will usually serve.



The brackets are cut from steel plates, as shown, the projecting ends are bent to form hooks, and chains fastened to the outside corners.—A. K.

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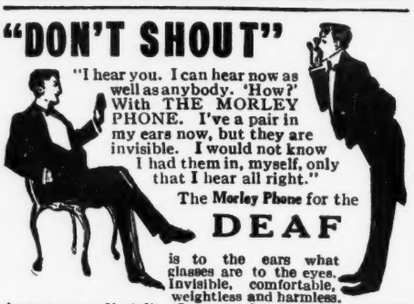

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The Shipshape Home
How to Do the Odd Jobs

Painting Cracked Walls

To paint successfully a plaster wall that is badly cracked requires covering the wall with muslin or canvas. Sandpaper down the edges of the cracks wherever one edge extends beyond the other and cut out any loose parts. Fill in all large openings with plaster of Paris and make the wall as smooth as possible. The plaster should then be given a coat of glue size, either a commercial variety or ordinary glue size mixed with about ½ pt. of heavy molasses to each gallon of size.

For sticking the muslin to the wall, use a heavy flour paste with about 1 pt. of glue size to a bucket of paste. Cut the canvas into strips as long as necessary and, after pasting a width of plaster, hang a sheet of dry canvas and press it firmly against the wall. Apply the next strip in the same way with an overlap of about 1 in. Then place a straight edge on the overlapped portion and cut through the two thicknesses with a sharp knife. Remove the two waste edges and paste down the edges of the strips to make a neat butt joint.

When the canvas is thoroughly dry, prime it and apply the finishing coats of paint as on any other wall.—F. B. E.

Kitchen Floors

Because of the excessive wear on wooden kitchen floors, they require unusual care to keep them looking well.

A varnished floor is the most brilliant in appearance and is often preferred, although considerable work is entailed in keeping it in condition. To start with, the floor should have two or three coats of first class standard floor varnish and another coat should be given every four or six months.

Probably the easiest and simplest method of treating the kitchen floor is to oil it frequently with boiled linseed oil thinned with turpentine.

If it is desired to keep the color very light, use about equal quantities of the oil and turpentine. If the proportion of oil is increased, the finish will have more body and will be darker. If a still darker finish is desired, add a small quantity of dry color, such as raw umber, burnt umber, or burnt sienna. Two coats should be given, especially if a half and half mixture is used at the first application, and the floor should be oiled at regular intervals.—C. N. J.

Tricks in Staining

In staining woodwork it is often necessary to compensate for the varying color of the natural wood. Soft woods sometimes show light and dark bands in the one piece and usually some boards of almost any kind of wood will prove to be different in color or distinctly harder or softer than the rest of the stock.

The simplest way to overcome this uneven coloring is to give the harder spots an extra coat of stain when the first coat is dry. Blend the edges into the main color.

Another method that is perhaps quicker when a large amount of staining has to be done is to dilute some of the stain for use on the softer and darker parts and strengthen another part of the stain to color the hard and lighter portions.—D. Y. H.

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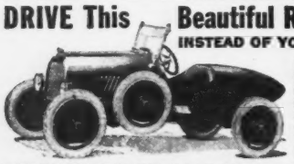

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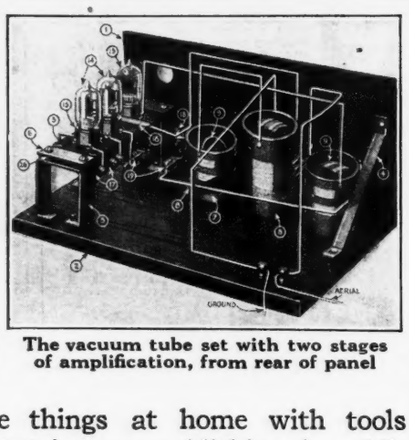

The vacuum tube set with two stages of amplification, from rear of panel

For men who like to make things at home with tools POPULAR SCIENCE MONTHLY is now publishing, in addition to its popular woodworking plans, an invaluable radio blueprint. This blueprint is easy to understand; the receiving set described requires the purchase of the fewest possible number of parts.

Should Receive 500 Miles

Under favorable conditions, if a long, high aerial is used, this receiving outfit will receive 500 miles. The blueprint contains working drawings, instructions, and bill of materials of a two-stage regenerative receiving set that a professional would be proud to own. It comprises a variocoupler and an Armstrong two-variometer-regenerative tuning circuit coupled, if desired, with two stages of audio frequency amplification.

The tuning coils have been selected because of the ease with which they may be constructed at home.

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Popular Science Monthly,
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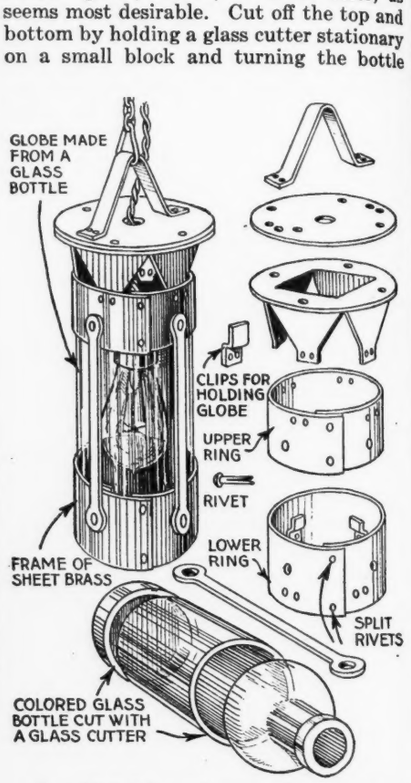
P. S. Aug. 1923

THE HOME WORKSHOP

Ornamental Hand Wrought Hall Light Costs Little to Make

A DECORATIVE hanging hall lamp to replace the ordinary frosted globe droplight so often used in porch, hall, archway, or den, can be made from a bottle and a piece of brass from 1/32 to 1/16 in. thick.

Choose a quart size or larger bottle of an artistic green, brown, or other color, as seems most desirable. Cut off the top and bottom by holding a glass cutter stationary on a small block and turning the bottle against it with the left hand. The globe should be about 4 in. in diameter and 7 in. long.



An old bottle and some sheet brass, artistically hammered or tinted, make this porch or hall lamp

Form a strip of brass into rings for the top and bottom of the holder and fasten with small split rivets. Small brackets are riveted to the lower ring to hold the glass, and the two rings are connected by means of strips. Then make up the upper member, as shown, to hold the light socket. Provide ventilating holes and fasten a metal strap to the upper disk for holding the supporting chain.

To provide an artistic finish for the brass surfaces, either go over them with green tinted shellac after the parts are made up, or hammer the brass before cutting it up with the round end of a ball-peen hammer to give the beaten appearance of hand hammered metal.—C. L. F.

Polishing Fine Furniture

FOR freshening up fine furniture, whether varnished or French polished, a veteran furniture finisher recommends mixing 4 oz. of vinegar, a dessertspoon of sulphuric acid, 2 oz. of butter of antimony, 2 oz. of white mineral oil, and 1 teaspoon of French chalk in a pint of water. Add the ingredients to the water in the order given, apply with a rag, and dry the surfaces with a soft cloth. Turpentine, vinegar, denatured alcohol and raw linseed oil in equal parts is another standard mixture

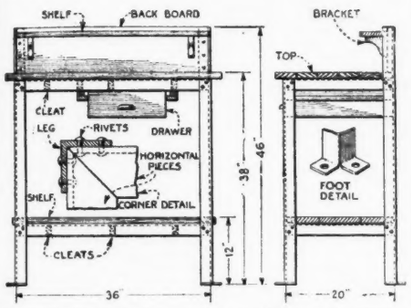
THE HOME WORKSHOP

Home Garage Workbench has Light Angle-Iron Frame

THE frame of this useful and easily made bench for the home garage or workshop is 2-in. angle iron.

The two front legs are cut roughly 40 in. long, and the back legs, 48 in. long. All four are then cut 1¾ in. deep at one end and the feet are bent, as shown, while hot. The legs are then cut to the exact lengths indicated.

The rails are mitered at the corners, placed together and rivet holes ¼ in. in diameter drilled.



This angle-iron bench, although small, is strong and serviceable and inexpensive to build

Holes spaced 3 in. apart are also drilled in the four end rails to take wood screws for attaching the top and the lower shelf.

The frame is next riveted together and the cleated wooden top, preferably ⅞-in. maple, is fastened in place. Pine or cypress will do for the shelf.

The back is then fitted and fastened with screws through the back legs, and the small shelf and brackets added. The top can be left natural or oiled, the other woodwork painted or shellacked, and the ironwork painted or enameled black, gray or other color, as preferred.—H. L.

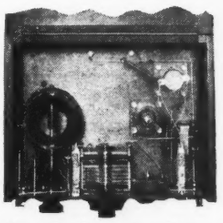
Exceptional Features to Appear Next Month

MANY articles of exceptional value to the home worker will appear in the September POPULAR SCIENCE MONTHLY.

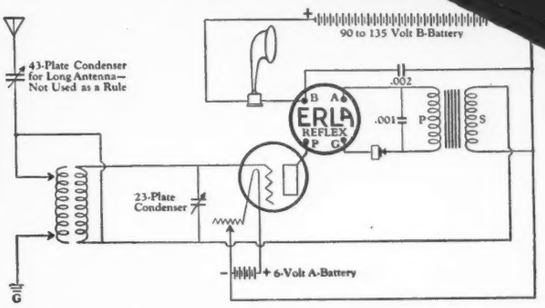
One will tell how to make a baby's combination crib and play pen. Another will give complete details for making a one-tube radio receiving set of the Flewelling type. A third will show a unique arrangement for installing light machine tools in the home workshop. A fourth will present a novel method for building at small cost a powerful compound microscope.

There will be a page of twelve hints on repairing your auto, and the usual features, including the Shipshape Home.

How to Get t… Out of One Tu…



Duo-Reflex simplicity assures neat, compact, cabinet installation. Detailed blue prints are on sale by dealers at 25c per set



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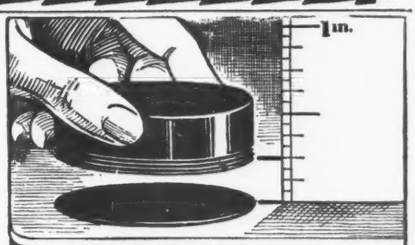

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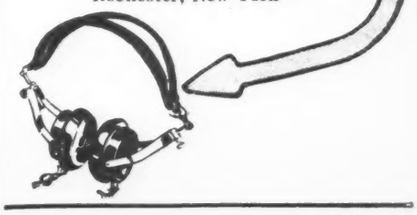

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When you want to drill metal—

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